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HANDBOOK
OF THE
9-2-INCH B. L. GUNS.
LAND SERVICE
1902.

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OF THE

9·2-INCH B.L. GUNS.

LAND SERVICE.



1902.



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ADDENDUM TO DRILL IN HANDBOOK

FOR

57
Colchester
5148

9·2-INCH B.L. GUN MARK X. ON CARRIAGE, B.L. BARBETTE MARK V.

DRILL FOR LOADING WITH DERRICK AND WINCH.

On "Prepare for Action," 3 brings up the tackle and hooks it into the derrick and passes the running end down to 9 and 10, who make it fast to the winch.

On the command "Load," 9 and 10 run a shell barrow with shell under the tackle, with selvagee or eye-bolt fixed.

With lyddite shell, eye-bolts will invariably be used.

9 hooks lower block into eye-bolt or selvagee, and assisted by 10 mans the winch handle, 7 steadying the projectile.

7, 8, 9, and 10 will change rounds as required.

5 gives "high enough," guides the projectile over the loading tray, and gives "lower."

3 swings round the loading tray and 5 unhooks the tackle.

3 removes the eye-bolt or selvagee and 5 swings back the derrick.

3 and 5 then man the rammer. When the shell is home and the cartridges have been put in, 3 passes the eye-bolt or selvagee down to 9, and 5 overhauls the tackle.

HANDBOOK

OF THE

9·2-INCH B.L. GUN.

(Controlled and Uncontrolled.)

(LAND SERVICE.)

[NOTE.—This Handbook is corrected up to November, 1901. Any alterations which may be suggested should be forwarded to the Chief Inspector, Woolwich.]

GUNS.

			MARKS C. I, AND U.C. I.	MARKS IV, C. IVA, U.C. IVA, VI, VIA, VIB, VIC.
FUNCTIONS OF GUN.	Material .. ..	..	Steel and wrought iron ..	Steel.
	Length, total .. ..	..	235·8 inches ..	310 inches.
	Weight, with fittings ..	..	22 tons ..	IV to IVA 23 tons, VI to VIB 22 tons.
	Preponderance .. ..	..	Nil ..	Nil.
	Bore { diameter .. ..	..	9·2 inches ..	9·2 inches.
	{ length .. ..	..	235·23 inches ..	289·8 inches.
	{ capacity .. ..	..	17,163 cubic inches ..	21,535 cubic inches.
	Chamber { diameter .. ..	..	11 inches ..	12 inches.
	{ length .. ..	..	44 inches ..	43 inches.
	{ capacity .. ..	..	4,300 cubic inches ..	4,950 cubic inches.
	{ system .. ..	..	Polygroove, hook section..	Polygroove, hook section.
	Rifling { twist* .. ..	..	Increasing from 1 to 118·5 calibres at breech to 1 in 35 calibres at 81·12 inches from muzzle, re- mainder uniform 1 in 35	Uniformly increasing from 1 in 60 calibres at breech end of rifling to 1 in 30 calibres at muzzle.
	{ length .. ..	..	187·73 inches ..	243·4 inches.
	{ grooves { number .. ..	..	37 ..	37.
	{ depth .. ..	..	0·05 inch ..	0·05 inch.
	{ width .. ..	..	0·6 inch ..	0·6 inch.
	Means of rotation .. ..	..	Driving band ..	Driving band.
	Venting .. ..	..	Axial ..	Axial.
	Angle of deflection for drift	..	1 degree 40 minutes ..	1 degree 40 minutes.
	Radius of sights .. ..	..	77·5 inches ..	60 inches.
	Firing mechanism .. ..	..	Percussion and electric ..	Percussion and electric
	System of obturation ..	..	Pad ..	Pad.
Ballistic effects	{ muzzle velocity ..	..	1,781 ..	2,065
	{ in foot-secs. ..	..	..	..
	{ muzzle energy in ..	..	8,406 ..	10,915
	{ foot-tons ..	..	..	..
	{ penetration of ..	..	..	..
	{ W.I. at 1,000 ..	..	15·9 ..	18·8
	{ yds. in inches. ..	..	..	..

* No. 33 gun was rifled with a twist increasing from 1 turn in 120 calibres at the breech to 1 turn in 30 calibres at 123 inches from the breech, remainder uniform 1 turn in 30 calibres. This gun was not through lined like those which were manufactured afterwards, as shown in Plate II.

			MARK IX.	Mark X and Xv.
Material .. ..	..	..	Steel (wire construction)	Steel (wire construction).
Length, total ..	..	..	445.25 inches ..	442.35 inches.
Weight .. ..	..	..	27 tons ..	28 tons.
Preponderance ..	..	..	Nil* ..	Nil.
Bore {	diameter ..	..	9.2 inches ..	9.2 inches.
	length ..	..	430.0 inches ..	429.33 inches.
	capacity ..	..	32,426 cubic inches.	32,235 cubic inches.
Chamber {	diameter {	..	13 inches, largest ..	13 inches, largest.
	length ..	..	9.8 " smallest ..	10.2 inches, smallest.
	capacity ..	..	71.215 inches ..	71.0 "
	system ..	..	8,123 cubic inches ..	8,123 cubic inches.
Rifling {	twist ..	..	Polygroove, plain sections	Polygroove, modified plain section.
	length ..	..	Straight from breech end of rifling to 303.585 inches from the muzzle, the remaining 303.585 inches increasing from 0 to 1 turn in 30 calibres at muzzle	Straight from breech end of rifling to 303.585 inches from the muzzle, the remaining 303.585 inches increasing from 0 to 1 turn in 30 calibres at muzzle.
	number {	..	354.685 inches ..	353.8 inches.
	depth {	..	37 ..	37.
grooves {	width {	..	straight, 0.08 inch ..	straight, 0.08 inch.
	twist, 0.06 inch ..	..	twist, 0.06 inch ..	twist, 0.06 inch.
	width {	..	straight, 0.62 inch ..	straight, 0.62 inch.
Means of rotation ..	..	..	twist, 0.602 inch ..	twist, 0.602 inch.
Venting .. ..	..	..	Driving band ..	Driving band.
Angle of deflection for drift	..	..	Axial ..	Axial.
Radius of sights ..	..	..	3 degrees ..	No sight on gun.
Firing mechanism ..	..	..	87 inches ..	
System of obturation ..	..	..	Percussion and electric ..	Percussion and electric.
Ballistic effects, with full charge {	muzzle velocity {	..	Pad ..	Pad.
	in foot-secs. {	..	2,601 = 100 lb. charge	2,613
	muzzle energy {	..	2,613 = 103 " "	
	in foot-tons {	..	17,826 = 100 " "	18,410
	penetration of W.I. at 1,000 yds. in inches {	..	18,410 = 103 " "	
		..	27.5 = 100 " "	28.83
		..	28.83 = 103 " "	

* Nos. 134, 135, and 140 guns have breech preponderance, all others have a counterpoise at the muzzle; in some cases this is shrunk and screwed on, in other cases it is formed solid with the A tube in manufacture.

C MARK I GUN.

(Plate I.)

The gun consists of the A tube, of steel, around which are shrunk the 1B coil, of steel, and 5 steel hoops extending to the muzzle, the breech-piece, of coiled wrought iron, being shrunk over the rear. Immediately in front of the breech-piece are shrunk the 1C coil of wrought iron, and the 2C hoop of steel. The D coil, or jacket of wrought iron, to which the trunnions are forged being shrunk around the breech-piece and overlapping the 1C coil.

A bronze sheath, for balancing the muzzle preponderance, is shrunk over the breech end; it has a plane for clinometer on top.

The A tube is fitted with a steel liner, extending from the seat of the obturator to a length of 141 inches, the liner being secured at the breech end by a steel ring screwed into the A tube.

The chamber is cylindrical, terminating in front with a curved slope.

U.C. Mark I differs from the above in the breech fittings. See pages 7 and 10, and firing mechanism, page 11.

MARK IV GUN.

The gun is made of steel and consists of the A tube around which are shrunk the breech-piece, prolonged at the rear for the reception of the screw, the 1B, 2B, 3B, 4B, 5B, and 6B hoops extending from the breech to the muzzle.

Over the breech-piece and portion of the 1B hoop, are shrunk the jacket and trunnion, respectively secured longitudinally by interlocking, the former with the breech-piece, the latter with the breech-piece and 1B hoop.

The C hoop is shrunk over the 1B hoop in front of the trunnion.

The A tube is fitted with a steel liner extending from the seat of the obturator to a length of 146 inches, the liner being secured at the breech end by a steel ring screwed into the A tube.

The chamber is cylindrical.

A plane for clinometer is prepared on jacket, near the rear on top. A band for attaching the elevating gear is shrunk over the jacket near the breech.

A bronze frame for carrying the mechanism is secured to the breech end by fixing screws.

For breech mechanisms, see pages 9, 10, and 11.

MARK IVA GUN.

(Plate II.)

Differs from the Mark IV in having two steel cylinders, one extending throughout the chamber, designated "chamber liner," and the other throughout the rifled portion of the bore, designated "bore liner." Mark IV guns, when through lined in this manner, have also the Mark II rifling.

C. and U.C. differ from IVA in breech fittings only. See pages 9, and 10 to 12.

MARK VI GUN.

(Plate III.)

The gun is of steel and consists of the A tube, over which is shrunk the breech-piece prolonged at the rear for the reception of the screw, the 1B and 2B tubes extending to the muzzle. The 1C and 2C hoops are shrunk over the 1B and 2B tubes. The trunnion is shrunk over portions of the breech-piece and 1C hoop, securing them longitudinally by interlocking. The jacket is shrunk over the breech-piece, interlocking with it. The D hoop being shrunk over the 1C in front of the trunnion.

Parallel portions are formed on the 1C and D hoops as seatings for the sight rings.

The chamber is similar in form to that of other 9.2 inch B.L. guns.

For breech mechanisms, see pages 10 and 11.

MARK VIA GUN.

Differs from the Mark VI in contour, and in having a thicker A tube. The 1B tube also does not extend so far to the rear.

MARK VIB GUN.

Differs from the Mark VI in having 1B and 2B hoops instead of the 1B tube, and a thinner A tube.

MARK VIC GUN.

The gun differs from Mark VI in having the 1B and 2B hoops substituted for the 1B tube. Shoulders are formed on the A tube, over the powder chamber to give greater longitudinal strength, which require the breech screw to be bushed at the rear.

MARK IX GUN.

(Plate IV.)

The gun is constructed of steel, and consists of an A tube, with an inner A tube extending from the seat of the obturator to the muzzle. The inner A tube is secured longitudinally to the A tube by means of corresponding shoulders and a steel breech-bush, which is screwed into the A tube at the rear; the breech-bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round a portion of the A tube, the ends being secured to steel rings provided for the purpose. B tube is shrunk round the A tube immediately in front of the wire, extending to the muzzle. Fitted over the exterior of the wire and overlapping a portion of the B tube is a jacket secured longitudinally by means of corresponding shoulders on the B tube, and a screwed steel bush at the rear. A trunnion ring is screwed over a portion of the exterior of the jacket.

The central portion of the chamber is cylindrical, with curved slopes in front, and coned rear.

The exterior of the jacket is prepared with seatings for the reception of the sighting and elevating band. Two metal brackets are fixed to the trunnion ring for the foresights, and two steel brackets for securing the tangent sight clamps, when in position on the gun, are fitted to the sight ring.

A plane for clinometer is prepared on the upper surface of the jacket at the breech.

For breech mechanisms, *see* page 12.

MARK X GUN.

(Plate IVa).

This gun is constructed of steel, and consists of A and B tubes, a series of layers of steel wire, and jacket. In the interior of the A tube is an inner A tube, secured longitudinally by means of corresponding shoulders, and a steel breech bush, which is screwed into the A tube at the rear; the breech bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round the A tube, the ends being secured by steel rings

provided for the purpose. The B tube is fitted over the exterior of the wire, extending from the breech to the muzzle. The jacket is fitted over the exterior of the wire in rear and a portion of the B tube, and is secured longitudinally by corresponding shoulders on the B tube, and by a screwed steel collar over the A tube at the rear. The gun is without trunnions. Two projections round the jacket, near the breech, and a key form a seating for the rear band connecting the gun to the mounting; the key is on the under surface of the jacket, and is formed when milling to shape the front projection.

The central portion of the chamber is cylindrical, reduced in diameter with curved slopes in front, and curved at the rear.

A plane for clinometer is prepared on the upper surface of the jacket at the rear.

Sighting lines are formed on the horizontal axis of the gun at the breech, and on the horizontal and vertical axes at the muzzle.

A hole is provided in the left face of the bronze end frame for loading tray steady pin.

For breech mechanisms, *see* pages 14 to 15.

MARK XV GUN.

There are only two guns of this description in the service. The gun differs from Mark X in the construction, and consists of an A tube with an inner A tube, both extending the whole length of the bore, the A tubes forming the chase. Layers of flat wire over the A tubes extend from the breech to a little more than half the length of the gun. Over the exterior of the wire is the jacket, having a breech bush screwed into it to take the breech screw.

The breech mechanism is the same in both marks.

THE BREECH MECHANISMS.

Two arrangements for opening and closing the breech are employed with these guns, respectively termed the "Controlled," and the "Uncontrolled." In the former the operations of opening and closing the breech are entirely effected by mechanism, in the latter the breech-screw is merely locked or unlocked by the ratchet lever.

UNCONTROLLED MECHANISM.

U.C. MARK I GUN.

(Plate V.)

The breech is closed by a screw having four portions of the thread removed longitudinally, each one-eighth of the circumference. The interior of the gun at the breech being prepared in a similar manner, admits of the screw (when the raised portions are placed opposite the smooth surfaces in the gun) being driven home and locked by the eighth of a turn. In order to lessen the wear of the threads on the lower surface of the breech-screw while it is being withdrawn or replaced in the gun, to take the bearing a small curved piece of very

hard steel, termed "bearing strip" or "riding strip," is attached to it by screws, the strip is a little higher than the screw threads; a thread is removed from the left lower screwed part of the gun, thus a recess is formed for the breech-screw when it is turned to the locked position.

To the right side of the breech is hinged a carrier, to receive the breech-screw when withdrawn from the gun.

The carrier is retained in its firing position by a lever engaging with a stud on the left side of the breech. When the screw is drawn clear of the gun, a groove on its under surface, coming in contact with the end of the lever, releases the carrier automatically, and admits of it being swung into the loading position. A spring catch fitted to the carrier, engages with a stud on the right of the breech and serves to retain the carrier open, the catch being released by depressing the lever handle on the left of the carrier. A spring stop bolt, actuated by a crank lever, enters a recess in the breech-screw when the breech is open and secures it on the carrier. In closing the breech the stop-bolt is withdrawn automatically by the arm of the lever coming in contact with the breech of the gun which leaves the screw free to be pushed home.

To the outer face of the breech screw is fitted a bronze end plate, furnished with a hinged cam lever, by means of which the screw is worked. The cam portion of the lever falls into a recess in the gun when the breech-screw is locked and the lever depressed, thus preventing any movement during firing. This lever acts in a fourfold capacity, (a) as a lever for turning the screw, (b) after turning as a prise giving the first movement to the rear in withdrawing, (c) as the screw is being turned for locking, it acts as a tell-tale, and cannot fall into its position until the turn is fully completed, (d) as a lock in the firing position.

The cam lever is held in its elevated position by a spring catch, fitted to the left lug of the breech-screw.

To release the obturator when the breech-screw is unlocked the cam lever should be partially lowered by depressing the lever of the catch.

A catch is provided for retaining the lever when depressed.

When the cam lever is elevated, it engages a gudgeon projecting from a block sliding in a recess formed in the upper part of the breech. This block is attached to the ratchet (Stanhope) lever by two links, the short one having the ratchet wheel which is provided with a reversible double pawl, the arms of which gear, by means of a spring pin, with the teeth of the ratchet wheel. The ratchet lever pivots on a fixed axis on the upper left side of the breech, and in combination with the links of the ratchet lever affords great mechanical power in turning the breech-screw, both in opening and closing the breech. The double pawl is reversed automatically by being brought into contact with projecting studs, one on the breech of the gun when the screw is in the locked position, and the other on the shorter arm or link of the ratchet lever, when the screw is in the position for withdrawing. A small lever is fitted to the pawl for reversing it by hand when desirable.

The ratchet lever is held in position when not in use by a "catch retaining."

MARKS IV, U.C. IVA, VI_B GUNS.

(Plate VI.)

The breech is closed by a screw having five portions of the thread removed longitudinally, each one-tenth of the circumference. The interior of the gun being prepared in a similar manner, admits of the screw, when the raised portions are placed opposite the smooth surface in the gun, being driven home and locked by the tenth of a turn. The breech-screw is prepared for the "bearing strip" as in Mark I.

Encircling the rear end of the breech screw, and hinged to the bronze frame is a carrier ring which supports the screw when withdrawn. The ring is provided with bearing rollers to facilitate the movement of the breech-screw, and to lessen friction at the hinge, a roller frame with seven coned rollers is fitted.

The carrier ring is held to the gun during the withdrawal of the breech-screw by a clip, pivoted within the left side of the ring, engaging with a recess in the bronze frame.

A stop bolt in the right side of the carrier ring prevents the breech-screw being disengaged from the carrier when withdrawn; at the same time the clip is disengaged from the recess in the bronze frame, by means of a spring, which forces its opposite end into a recess in the breech-screw, thus securing the latter in the carrier ring. When in this position the whole can be swung clear of the breech opening to admit of loading.

The ring is retained in the loading position by a spring "latch."

In closing the breech the lower arm of the clip is depressed by coming in contact with an inclined plane in the bronze frame, and the clip being pivoted is consequently released from the recess in the screw, leaving it free to be pushed home.

To the outer face of the breech-screw is fitted a bronze end plate furnished with a hinged cam lever by means of which the screw is locked and unlocked.

The cam portion of this lever when the breech-screw is locked, falls into a recess in the carrier ring and so prevents any movement of the breech-screw during firing. On depressing the cam lever after the breech-screw is unlocked, the cam acts upon the surface of the carrier ring, partially withdraws the screw together with the obturator.

The cam lever is held in its elevated position by a spring catch fitted to the left lug of the breech-screw. The lever may be partially lowered for the purpose of releasing the obturator by depressing the lever of the catch. When the breech is closed and the cam lever lowered it is retained in position by a spring catch cam lever down in the carrier ring.

When the cam lever is elevated, it engages a gudgeon projecting from a block sliding in a recess in the upper part of the bronze frame. This block is attached to the ratchet (Stanhope) lever by two links, the short one having the ratchet wheel, which is provided with a reversible double pawl, the arms of which gear by means of a spring pin with the teeth of the ratchet wheel. The ratchet lever pivots on a fixed axis on the upper left side of the breech, and, in combination with the links of the ratchet lever, affords great mechanical power in turning the breech-screw, both in opening and closing the breech.

The double pawl is reversed automatically by means of a tappet attached to the ratchet wheel, which thereby changes the direction of

motion round the axis. A small lever is fitted to the pawl for reversing it by hand when desirable. A catch is provided for retaining the ratchet lever when not in use.

CONTROLLED MECHANISM.

C. MARK I GUN.

(Plate VII.)

Guns fitted with controlled mechanism have, in addition to the previously described gear, a rack fitted into a dovetailed groove, cut in an unthreaded part on the right side of the breech-screw. A pinion which gears with the rack is keyed to the hinge bolt of the carrier. To the bolt is also attached, by means of a clutch, a worm wheel which gears with a worm and spindle fitted to the lower part of the breech end of the gun. The whole is so arranged that in turning the spindle in one direction the screw is withdrawn from the breech opening on to the carrier, and upon further action the carrier, together with the screw, is swung into the loading position.

The reverse of this action takes place in closing the breech.

In the event of accident to the controlling mechanism, the breech-screw may be withdrawn and swung into its loading position by hand, the clutch having previously been detached from the worm-wheel.

A keep pin attached by a chain to the carrier is also provided for holding down the "catch retaining carrier open."

C. MARK IVA, AND MARKS VI, VIA, VIC GUNS.

(Plate VIII.)

These guns also have a rack fitted to the right side of the breech-screw. A pinion, which gears with the rack, is keyed to the hinge-bolt of the carrier ring. To the bolt is also attached, by means of a clutch, a worm-wheel, which gears with a worm and spindle, fitted to the bronze frame. The whole is so arranged that in turning the spindle in one direction the screw is withdrawn from the breech opening into the carrier ring, and upon further action the ring, together with the screw, is carried into the loading position.

The reverse of this action takes place in closing the breech.

In the event of accident to the controlling gear, the breech-screw may be withdrawn, and swung into its loading position by hand, the clutch having previously been detached from the worm-wheel.

To retain the carrier ring open when required, a spring latch is provided, which can be put out of action by raising the small lever attached to it.

A bronze cover is provided for the protection of the rack pinion and worm-wheel.

Obturation, Marks I to VIC of before-mentioned Guns.

The system of obturation consists of a circular pad with protecting discs fitting the mouth of chamber, placed between the head of the axial vent and the breech-screw. For weight of pads, see table, page 15.

The pad being slightly elastic expands radially when compressed by the action of the powder gas, thus sealing the escape.

Thin discs of steel are used to adjust the required thickness of the obturating pad.

Firing Mechanism, Marks I to VI of before-mentioned Guns.

The firing arrangement is so designed that the gun cannot be fired before the screw is in the locked position, and the cam lever depressed.

It consists of a steel vent furnished with a spring and nut passing through the longitudinal axis of the breech-screw, having on its outer end a slide box in which either the electric or percussion lock is moved into and from the firing position, by depressing or raising the cam lever, by means of a link which gears the lock with a groove in the side of the lever.

Electric Firing.—The electric lock "B" (Plate IX) is used; it consists of a steel frame having a projecting arm (a) in which is an insulated contact (b), the upper part of the contact is kept pressed outwards by a spiral spring (c) fitted to the lower end of which is a terminal point (d), over which one of the tube wires is placed, aluminium block (e) and cap (f). The frame is furnished with a spring guide bolt (g) engaging with a link attached to the cam lever, by means of which the lock is brought down into the firing position, when the cam lever is depressed. The lower portion of the frame is fitted with an extractor for removing the tube after firing. When the lock is raised, the wedge-shaped extractor is forced under the head of the tube, thus releasing it from the vent. A lanyard with toggle (k) is attached to the extractor. To prevent the extractor from flying back on firing, its lower end is prolonged beyond the axis pin, forming a projection (m).

A contact is fixed on the upper right side of the breech, furnished with an insulated terminal for the reception of the return wire from the electric vent-sealing tube, the tube wires being untwisted before use, one end is attached to the terminal in the lock, and the other end to the upper terminal. The contact bracket and electric lock are so arranged that, when the screw is home and the cam lever lowered, contact is made.

Percussion Firing.—The percussion lock "D"* (Plate IX) consists of a frame (A) fitted with a striker (B), with firing pin (b), spindle (c), keep-pin, spiral spring (d), and cap retaining (e); C, trigger, with axis pin (g), and spiral spring (h); D, cocking lever, with axis pin (l); E, extractor, with axis pin (n), spiral spring (o), and lanyard (p), with toggle; F, guide bolt, with spiral spring (r), handle (s), and keep-pin.

The guide bolt of the lock fits into a recess in a sliding link, and is worked up and down by the cam lever; when the latter is raised the lock is cocked automatically. The cocking lever has three arms, the one (i) gears into a recess in the slide box causing the lever to revolve, the arm (j) pushing the spindle (c) back and compressing the main-spring (d), which is retained in the cocked position by a projection on the lower part of the trigger catching the lug of the spindle, the trigger being pressed downwards by the small spiral spring on its axis. On lowering the cam lever, the cocking lever is reversed, and its lower arm clears the spindle, which, on raising the

* For above guns on *barbette* carriages, for disappearing carriages see footnote, page 12.

trigger, is free to fly forward and carry the striker on to the tube. The third arm (k) has its upper surface roughened, and is kept pressed down by the finger while taking the lock in or out of the slide box.

The trigger is fitted with two loops ($r^1 s^1$), to either of which the lanyard may be attached, one (r^1) being for a horizontal pull to the rear, the other (s^1) for a pull in an upward direction. The lower portion of the frame is fitted with an extractor, similar to that described for the electric lock "B."

See footnote *.

MARK IX GUN.

(Plate X.)

Breech-closing Mechanism, Controlled.

A bronze frame for the attachment of the mechanism is secured to the breech end of the gun by fixing screws.

The breech-screw is closed by a parallel screw having six portions of the screw-thread removed longitudinally so as to admit of the breech being closed (when the breech-screw is pushed home) by the 12th of a turn.

A bronze carrier ring for supporting the screw when withdrawn is hinged by a bolt to the bronze frame. To the hinge bolt of the carrier ring is secured a worm wheel which engages with a worm and worm spindle fitted to the lower part of the frame. The hinge bolt is also fitted with a bevel wheel and rack pinion, the former engaging with a bevel wheel with friction roller on the carrier ring, and the latter with the rack on the breech-screw, in such a manner that, when the hinge bolt is revolved in one direction, the friction roller engages with a roller path prepared for its reception in the end plate of the breech-screw, and turns the screw into the unlocked position; the rack pinion then engages with the rack on the breech-screw, and withdraws the latter, the whole being then swung round into the leading position. A catch is fitted on the breech mechanism frame engaging with a ratchet wheel on the worm spindle in such a manner as to retain the carrier in the "open" or "closed" position. The reverse action takes place when the hinge bolt is reversed in the opposite direction.

In the event of accident to the controlling gear, the breech-screw may be withdrawn and swung round into the loading position by hand, a cam lever being provided for this purpose. When the cam lever is not in use the housing-block is filled by a preserving block.

Obturation.

The system of obturation is as for the previous marks of guns. For weight of obturators, see table, page 15.

Firing Mechanism.

The mechanism is so arranged that the gun cannot be fired until the screw is locked in the gun.

The gun is furnished with an axial vent prepared at its outer end for slide box for the locks, as under.

* For guns on disappearing carriages "lock, percussion, J" has been approved; it is converted from the percussion lock "D." The frame of the lock, *Plate IXa*, is in two parts. With this lock the striker is raised into the firing position, and then released, by means of a trigger and cocking lever, which are so arranged that the lock can be cocked and fired by one pull on the trigger. There is a loop on the outer end of the trigger, to which the lanyard may be attached.

Electric Firing (Plate XI).—The electric lock for wire tubes consists of a steel frame (a) fitted at the upper end with an actuating lever (b) with sleeve (c) by means of which it is raised or depressed, thus admitting the insertion or withdrawal of the tube from the vent. The lock is secured during firing by means of a catch on the actuating lever, which engages with a projection on the box slide when the lock is in the firing position. To prevent the lock from sliding out of the slide box, when the actuating lever is raised, a stop catch is fitted to the actuating lever which engages with a stop on the lock frame. When placing the lock in position or withdrawing it from the gun, the bronze nut of the stop-catch must be pressed in so as to allow the actuating lever to be raised beyond the stop on the lock frame, as it is only with the lever in this position that the lock can be inserted or withdrawn.

The lower portion of the lock is fitted with an extractor (d) and an insulated contact (e) having a terminal point (f) for the reception of one of the wires, electric, vent-sealing tube, *the tube wires being untwisted before use*, the other wire being placed over an insulated terminal point on the right side of the bronze frame in connection with the firing battery.

To the hinge joint of the carrier ring, and projecting through the side of the breech screw, is fitted a contact bolt, furnished with an insulated contact, in connection with the firing battery. The contact bolt is actuated by means of a cam groove in the rack pinion in such a manner that when the breech is closed the contact bolt is forced through the recess in the side of the breech-screw, and makes contact with the lower contact of the electric lock. In opening the breech, the first movement of the rack pinion serves to withdraw the contact bolt clear of the breech-screw, and thus admits the latter being unlocked and withdrawn.

The lock for wireless tubes differs from that described above for wired tubes, in being provided near the centre with an insulated aluminium crown metal connecting piece, having at one end a steel centre punch point, and connected at the other end by a braided wire cable to the insulated contact at the lower end of the lock. The upper contact is encased in a steel cover, actuated by a link fitted to the lock frame, which engages with the cam portion of the actuating lever, so arranged that when the lock is in position, and the lever depressed, the point of the contact is forced partially into the head of the V.S. tube, and contact made. The under side of the lock is provided with two serrated cutters, which grip the head of the V.S. tube, and ensure a clean surface for the earth return.

Percussion Firing (Plate XI).—The percussion lock consists of a steel frame furnished with an extractor, actuating lever, and stop catch, generally similar to those of the electric lock. The lock frame is fitted with a striker, main spring, trigger, and safety plunger. The striker is cocked automatically when the actuating lever is raised, and maintained in the cocked position by the trigger. The trigger is furnished with a loop for the attachment of the service lanyard. The safety plunger which is fitted to the lower portion of the lock frame serves to ensure that the vent-sealing tube is not detonated by the striker before the actuating lever is lowered. When the breech is closed and the actuating lever lowered, the safety plunger is automatically withdrawn from the striker, which is then free to strike the vent-sealing tube when the trigger is pulled.

MARKS X AND XV GUNS.

(Plates XIa and XIb.)

Breech-Closing Mechanism, Controlled ("Welin" System).

The breech is closed by a parallel screw, which differs from the ordinary interrupted screw in having a larger amount of thread in proportion to its length by arranging segments at varying diameters, the breech opening of the gun being prepared in a corresponding manner. The interruptions in the gun are arranged to accommodate the segments of the screw of largest diameter, thus, when the screw is unlocked, these segments pass into the interruptions, and the segments, next smaller in diameter, unlock into the spaces left vacant by the larger ones.

The breech screw is attached to the carrier by means of corresponding interrupted screw threads, and by a steel vent passing through the centre of the breech screw. The vent has a mushroom head at the inner end, behind which are placed the obturating pad and protecting discs. The vent is retained in position by means of a sleeve, spiral spring, collar and nut, in the carrier.

A manganese bronze carrier for supporting the breech screw is hinged by a bolt to the right side of the gun at the breech. The carrier and breech screw are opened and closed by means of a breech mechanism lever (A), pinion, and link (B). The lever is retained in the closed position by a catch fitted to the underside of the carrier.

A catch fitted to the carrier engages with a corresponding recess in the rear face of the breech screw when the breech is open, and retains the screw in the unlocked position. The catch is automatically disengaged from the screw in closing the breech. There is a hole in the left side of the breech mechanism frame for the stop of loading tray.

Obturation.

This is obtained by means of an asbestos pad and protecting discs, which fit into a coned seating in the gun, as previously described for the other Marks of gun, but which differ in the coned portions being made more acute, the seating in the gun for their reception being arranged at an angle of 13 degrees 14 minutes 48.7 seconds with the axis.

When the obturators require to be changed, care must be taken that the protecting discs issued with the pad are placed in the gun with it. A pad and its protecting discs must, in all cases, be replaced together. For weights, see table, page 15.

*Firing Mechanism.**Plate XIb.*

The firing mechanism is designed for percussion firing, and for electric firing with wireless tubes, and is so arranged that the gun cannot be fired before the breech is closed.

A box, C, in which the electric and percussion lock slides is secured to the outer end of the steel vent, D, the lock being pushed into a position over the vent by means of an actuating link in the rear face of the carrier, when the breech screw is locked in the gun. A safety slide fitted to the upper left side of the slide box serves to prevent contact, between the needle of the lock and the electric or percussion tube in the vent, before the breech is properly closed. An

extractor for releasing the vent-sealing tube from the vent is fitted to the slide box, and is actuated automatically by the lock in opening the breech.

The electric and percussion lock consists of a steel frame with an insulated steel needle, E, which is actuated by a mainspring. For the purpose of percussion firing, a cocking handle, F, is provided, by means of which the needle is pulled into the cocked position and retained by the trigger, G, which engages with a projection, H, on the sheath. The trigger can be pulled from either side of the gun by the firing arc, I.

For electric firing, the outer end of the needle of the lock is connected by a spring contact and electric cable to the firing battery on the mounting.

A spring guide bolt, K, is provided on the lock, which engages with the actuating link in the carrier.

ACTION OF THE MECHANISMS.

To Close the Breech.—Turn the breech mechanism lever from right to left, which will cause the carrier with breech screw to swing into the closed position. On continuing the motion of the lever, the screw is turned into the locked position by the link actuating breech screw, which is connected to a stud on the rear face of the breech screw, thus forming a crank. When the screw is locked in the gun the last motion of the breech mechanism lever forces the lock into a central position over the vent by means of the link actuating lock.

To Open the Breech.—This is the converse of the foregoing.

WEIGHTS OF OBTURATING PADS.

The obturating pads should weigh as stated in the following table, and if any pads are found not to be within these limits, steps should be taken to exchange them for others:—

Weights.

Nature of Gun.	Minimum.	Maximum.
Marks—	lb. oz. drs.	lb. oz. drs.
C. I. and U.C. I	6 14 8	7 10 3
IVc to VIc	8 8 0	9 5 13
IX	4 1 8	4 8 8
X to XV	5 13 4	5 15 12

REMOVING AND REPLACING BREECH MECHANISM.

Instructions to be observed in removing and replacing the breech mechanism. Care must be taken not to indent or damage the components: a hammer should never be used unless with a piece of wood or soft metal to transmit the blow: heavy parts, which cannot be lifted by hand, can be slung by salvages, and tackle suspended from the mounting or from any other suitable erection.

ORDER OF REMOVING THE MECHANISM.

C. Mark I Gun	<ul style="list-style-type: none"> 1 Lock. 2 Box, slide. 3 Vent, axial and obturator. 4 Breech screw and details. 5 Carrier with details. 6 Worm spindle. 7 Ratchet lever. 8 Catch, ratchet lever.
U.C. Mark I Gun	<ul style="list-style-type: none"> Same as for C. Mark I, with the exception of the worm spindle and worm wheel with clutch.
C. Marks IVA, and VI, VIA, VIC Guns	<ul style="list-style-type: none"> 1 Lock. 2 Box, slide. 3 Vent, axial and obturator. 4 Breech screw with details. 5 Carrier ring with details. 6 Catch, ratchet lever. 7 Worm spindle. 8 Ratchet lever.
Marks IV and VIB, and U.C. Mark IVA Guns	<ul style="list-style-type: none"> Same as for C. Marks IVA, VI, VIA, and VIC, with the exception of the worm spindle, and worm wheel with clutch.
Mark IX Gun	<ul style="list-style-type: none"> 1 Lock. 2 Box, slide. 3 Obturator. 4 End plate of breech screw. 5 Rack. 6 Breech screw. 7 Bevel wheel with crank. 8 Worm wheel. 9 Carrier ring with details. 10 Worm spindle. 11 Cover worm wheel.
Mark X and XV Guns ..	<ul style="list-style-type: none"> 1 Lock and box slide. 2 Vent, axial and obturator. 3 Breech screw. 4 Link actuating lock. 5 Carrier.

The following articles must be removed while the breech is closed:—

Mark I, IV, IVA, VI, to VIc Guns.

Electric lock "B."—Place the cam lever in the up position, withdraw the guide bolt of the lock clear of the link, and slide the lock out of the grooves of the slide box in an upward direction.

Percussion Lock "D."—Place the cam lever in the up position, the trigger of the lock must then be pulled to the rear by inserting the third finger of the left hand behind the loop for lanyard, the first finger at the same time being pressed on the latched position of the cocking lever. The cam lever must then be gently depressed until the projecting toe of the cocking lever is clear of the recess in the box slide; the lever can then be returned to the up position without cocking the lock, which can then be removed by withdrawing the guide bolt of the lock clear of the link, and sliding the lock out of the grooves of the box slide in an upward direction.

Ratchet Lever.—Remove the keep pin and washer from the axis pin of the ratchet lever, and unscrew the hinge bolt of the link, when the lever can be withdrawn. To remove the sliding block with gudgeon, the fixing screws of the steel plates forming the recess for the block must first be removed in the case of Mark I Guns, and the fixing screw and filling piece in that of the others.

Catch, Ratchet Lever.—Remove the keep pin and washer, and withdraw the catch.

Cam Lever.—Remove the keep pin and nut from the hinge bolt, when the latter can be withdrawn and the cam lever removed.

Catch, Cam Lever, up.—Remove the set screw in the end plate and withdraw the lever from the outside, and the catch with flat spring from the inside of the lug of the end plate.

Catch, Cam Lever, down.—Unscrew the axis pin and remove the lever, the catch with spiral spring can then be withdrawn.

Before removing the following fittings, the breech must be opened and the breech screw swung into the loading position, except where otherwise stated in the case of Marks IX and X Guns.

Marks I to IX Guns.

Box, Slide.—Turn the box slide until it engages with the stop on the end plate, the two portions of the box slide can then be separated to the right and left respectively till clear of the thrust collars on the vent, and withdraw to the rear.

Vent, Axial, and Obturator.—Unscrew the nut from the vent together with the obturator from the front end of the breech screw, the spiral spring and washer belonging to the vent can then be withdrawn from the recess in the end plate of the breech screw.

U.C. and C. Mark I Guns.

Breech Screw.—Press the projecting end of the lever directing stop from the front side of the carrier until the stop is disengaged from the under side of the breech screw, when the latter can be pushed forward sufficiently to admit of a selvagee being placed round it for lifting. The breech screw can then be pushed forward until clear of the carrier, the pressure on the lever directing stop being maintained until the breech screw is clear of the carrier.

Stop, breech screw. Stud, stop, carrier, open. Lever, retaining
(9784)

carrier closed.—Unscrew the fixing screw of the cover from the underside of the carrier and remove the cover. Unscrew and withdraw the axis pin of the lever directing stop breech screw and withdraw the lever, the stop with spiral spring can then be removed from the upper surface of the carrier. Remove the keep pin from the collar on the releasing spindle on the underside of the carrier when the spindle can be withdrawn and the lever directing with stud "stop, carrier open," and "lever, retaining carrier, closed" can be removed.

U.C. Mark I Gun.

Carrier.—Unscrew the set screw in the lower lug of the hinge joint until the point is clear of the hinge bolt when the latter can be pushed up from below and withdrawn. The washer between the carrier hinge joint and the underside of the top lug must then be pushed out, when the carrier can be slightly lifted to clear the cone of the lower lug, and withdrawn.

C. Mark I Gun.

Carrier.—Unscrew the guide screw in the clutch on the underside of the bottom lug of hinge joint, and remove the clutch. Two set screws in the collar under the worm wheel must then be unscrewed, care being taken to support the worm wheel while this is being done; the collar can then be withdrawn and the hinge bolt pushed up through the worm wheel and removed from above. The worm wheel and the rack pinion can then be removed. The washer between the carrier hinge joint and the under side of the top lug must then be pushed out, when the carrier can be slightly lifted to clear the cone on the lower lug, and withdrawn.

Worm Spindle.—Unscrew the fixing screws of the bracket, and remove the latter with worm spindle from the gun, the spindle can then be withdrawn from the bracket by removing the keep pin, nut, and lever.

Marks IV, IV_A, VI, to VIc Guns.

Breech Screw.—Press down the projecting end of the retaining clip in the carrier ring until the inner end of the clip is clear of the pocket in the breech screw, and push the latter through the carrier ring till the stop bolt can be withdrawn from the front of the breech screw. Force back the breech screw through the carrier ring into the loading position, and sling it, press down the retaining clip clear of the screw, when the latter can be withdrawn to the rear.

Carrier Ring.—Unscrew guide screw in the clutch on the underside of the bottom lug of the hinge joint and remove the clutch. Two set screws in the collar under the worm wheel must then be unscrewed, care being taken to support the worm wheel while this is being done, the collar can then be withdrawn and the hinge bolt pushed up through the worm wheel and removed from above. The worm wheel and rack pinion can then be removed. Sling the carrier ring as near the hinge joint as possible, and push out the steel washer from between the carrier ring hinge joint and the underside of the top lug, then lift the carrier ring till the hinge joint comes against the top lug, and withdraw the carrier ring. In withdrawing the ring care must be taken to catch the roller frame with the rollers and bearing plates, which will fall out at the lower end of the carrier ring hinge joint so soon as the ring is withdrawn.

Worm Spindle.—Take out the keep pin of the lever securing nut and remove the nut and lever. Knock out the flat keep pin from underneath the bracket and withdraw the spindle, the worm with the four washers can then be removed.

Mark IX Gun.

Electric Locks. Percussion Lock.—Press up the sleeve of the actuating lever clear of the catch on the lock frame, and raise the lever as far as it will go, at the same time pressing the milled head of the stop catch, and slide the lock out of the grooves in the box slide in an upward direction, and withdraw.

End Plate.—Unscrew the set screw of the cam lever hinge bolt and withdraw the bolt, when the distance piece for cam lever can be removed. Take out the fixing screws of the end plate and remove it.

Rack.—To take out the rack, the breech screw must be pushed through the carrier ring into the breech of the gun till the outer face of the screw is almost flush with the breech face of the gun, and turned to the left (by means of two of the fixing screws for the end plate, screwed into opposite holes in the breech screw and used as handles) till the projecting end of the rack comes against the stop on the carrier ring, when the rack can be withdrawn by a straight pull to the rear.

Breech Screw.—After the rack has been withdrawn, as previously described, the breech screw must be turned back to the unlocked position in the gun and pulled back through the carrier ring as far as it will go, the retaining clip in the carrier ring being pressed in by means of a piece of wood so as to engage with the groove in the breech screw, the carrier ring at the same time being held in the closed position. The breech screw and carrier ring can then be swung into the loading position and the breech screw withdrawn from the front of the carrier ring, the retaining clip being held clear of the screw by means of a screwdriver used as a lever.

Bevel Wheel with Crank.—Unscrew the set screw in the upper right side of the hinge joint, and remove the securing screw of the bevel wheel with crank, when the wheel can be withdrawn.

Carrier Ring.—Remove the fixing screw of the cover worm wheel and swing the cover open. Unscrew the set screw in the bottom lug of the end frame. Remove the preserving screw from the upper end of the carrier ring hinge bolt and screw in the eye bolt. Lift the hinge bolt clear of the worm wheel and withdraw the latter. Sling the carrier ring and withdraw the hinge bolt, when the bevel wheel, rack pinion, and contact bolt can be removed from the hinge joint. Withdraw the carrier ring from the end frame, taking care to catch the roller frame with rollers and bearer washers, which will fall out from the underside of the hinge joint.

Worm Spindle.—Unscrew the securing nut of the lever and withdraw the latter. Unscrew the set screw in the bracket and withdraw the worm spindle, the worm with the four washers can then be removed from the end frame.

Cover Worm Wheel.—Remove the axis pin, when the cover can be withdrawn.

Marks X and X' Guns.

Lock and Box Slide.—Draw back the guide bolt of the lock, then turn the lock and box slide through a quarter circle in a downward direction, and remove separately or together.

Vent Axial and Obturator.—The axial vent, with spring, nut, and washer, and the obturator, will be removed in the usual way, the sleeve which forms part of the axial vent being removed from the recess in the carrier to the front.

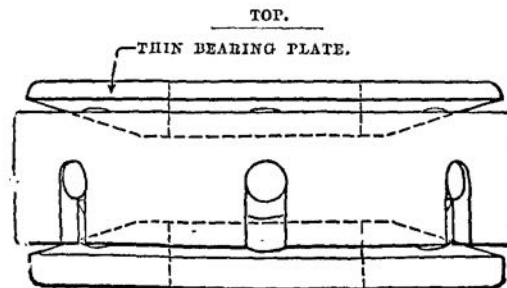
Breech Screw.—Disconnect the link actuating breech screw from link pinion by removing the check screw and axis pin, then turn the breech screw on the carrier until the actuating link is clear of its slot, and take off the link. Press the catch retaining breech screw clear of the recess in the breech screw, and turn the latter so as to disengage the screw threads on the interior of the screw from those on the carrier, and withdraw the breech screw. The catch retaining breech screw will then be forced out of its seating by the action of its spring.

Link Actuating Lock.—Unscrew the bush of the guide bolt about a quarter of an inch, draw back the guide bolt of the link, and slide the link from its groove in the carrier.

Carrier.—Sling this, as a preventative. Remove keep pin and nut from lower end of hinge bolt, and the preserving screw from the top end, replacing the latter by an eye bolt, by means of which the hinge bolt is withdrawn. Release set screw, and unscrew upper ball-bearing bush, and take out the anti-friction balls. Release set screw, and partly unscrew the lower ball-bearing bush, when the carrier can be withdrawn, complete the removal of the lower ball-bearing bush and anti-friction balls. Remove keep pin and nut from breech mechanism levers and withdraw the lever. Remove keep pin and nut from the link pinion stud, and withdraw the link pinion. Unscrew the fixing screws of bracket catch retaining breech mechanism lever, and remove the bracket, remove keep pin and nut, and withdraw catch and spiral spring through hole in bracket.

ORDER OF REPLACING THE MECHANISM.

The order in which the mechanism may be replaced will be the reverse of the foregoing. But, however, in the case of hinge bolts having coned roller frame, care should be taken to put the frame in position as shown in the sketch below; the anti-friction rollers being embedded in tallow or other fatty matter, which will serve to retain them while assembling the frame, and afterwards as a lubricant.



BOX, SPARE PARTS.

The box is made of deal, divided into seventeen compartments, and is intended to hold the spare springs and other small parts belonging to the gun.

APPURTENANCES, &c.

SIGHTS.

The guns are sighted on both sides, except Marks X and XV.

Mark I *foresights* are of the drop pattern, and consist of a pillar, jacket, and socket, with a steel acorn screwed into the pillar. The socket is permanently fixed in the gun. The pillar locks into the socket with a bayonet joint, and is secured from turning by a projection on the jacket, which drops into a recess in the socket when the sight is in its true position. The sight cannot be removed without first raising the jacket and turning the pillar round a quarter of a circle.

Mark II *foresights* differ from Mark I in being provided with a small steel acorn point and a sighting blade to facilitate laying. The sights are "left" and "right" respectively, and are so stamped, the vertical edge of the sighting blade being turned inwards in each case when the sights are in position in the gun. These foresights are interchangeable with all the L.S. Mark guns.

The *tangent sights* are of steel having bars triangular in section. The front faces have a degree scale (12° for Mark I gun and 15° for Marks IV to VI guns) and a rack which gears with the pinion of the automatic clamp "C." The rear faces are fitted with range strips graduated in yards (8,400 yards for Mark I gun, and 10,000 yards for Marks IV and VI guns) for a full charge, and stamped with the corresponding M.V.* The crossheads are fitted with a deflection leaf worked by a milled head screw capable of giving 2 degrees deflection right and left, and having a sight notch, 0.06 inch deep, for use when elevation and line are both to be obtained by means of the sights.

Mark II for the Mark I guns, and Mark III for the Marks IV and VI guns are made "left" and "right" respectively, and are so stamped. The vertical edges of the sighting blades on the crossheads are turned inwards, when the sights are in position in the guns, so as to correspond with the sighting blades of the foresights. Mark I and Mark II tangent sights for these guns, respectively, were not made specially for the right and left sides, and were used with the Mark I foresights.

On the leaf is engraved a zero mark, and the deflection scale is engraved on the corresponding upper face of the crosshead.

The leaf has a vertical sight blade of a height corresponding to about a mean length of 1,000 yards on the yard scale which is intended for use in conjunction with the elevation indicator, elevation being given by means of the latter, and line only by the sights. When using the sight blade, the sight should be clamped about 1,000 yards less than the estimated range of the ship, if the ship is approaching, and at the estimated range, if the ship is going away,

* In future manufacture the kind of charge will also be stamped on them thus, "P" or "C," denoting powder or cordite.

as by this means the gun can be laid for line at any time during the period the ship takes to move 1,000 yards.

The "clamp, tangent sight, automatic C" is used for clamping the above mentioned tangent sights.

The Mark I tangent sights for the Mark IX gun are of similar construction to those of the latest pattern for the previous marks of gun. The range strips are graduated similarly, too, but that on the front face to 8° , and the two on the rear faces up to 10,000 yards for a full charge, and also corresponding M.V. The automatic clamp B is used for clamping them; it is secured to the sight ring by a steel bracket.

The Mark II tangent sights for Mark IX gun differ from Mark I in having the cross-head traversing screw with a larger pitch thread; the sights are made right and left for guns on Marks III and IV barbette carriages respectively, each sight having two range strips, one for a full charge, and the other for a three-quarter charge, arranged and graduated thus:—

Mark I range strips	{ for Mark III	{ carriage	{ full cordite charge, 10,000 yds., and M.V. 2,601 f.s.			
			$\frac{1}{2}$	"	"	8,000 " " 2,127 "
	{ for Mark IV	{ carriage	{ full " " 10,200 " " 2,601 "			
			$\frac{1}{2}$	"	"	8,000 " " 2,127 "
Mark II range strips	{ for Mark III	{ carriage	{ full composite charge, 10,800 yds., and M.V. 2,643 f.s.			
			$\frac{1}{2}$	"	"	8,400 " " 2,196 "
	{ for Mark IV	{ carriage	{ full " " 11,000 " " 2,643 "			
			$\frac{1}{2}$	"	"	8,400 " " 2,196 "

Marks X and X^v guns are not fitted for sights. For automatic and rocking-bar sights, *see* pages 49 and 48 respectively.

OBTURATING PAD BOXES.

(Plate XIc.)

Box, Obturating, Pads, and Discs, B.L. 9.2-in., Marks I to VII Guns.—Marks I and II boxes differ from Mark III, in the former having iron screws and fittings; Mark II is slightly deeper than Mark I.

Mark III box is of wood, the sides being made of deal, ends and bottom of elm; top, battens, and internal fittings of mahogany. The sides are dovetailed to the ends, and the bottom is secured by brass screws. It holds 3 pads and 3 sets of discs.

The box is fitted with a false lid, a gunmetal bolt passes up through the bottom and both lids; each lid is secured with a fly nut, both nuts being on the before-mentioned bolt. The false lid thus secures the pads and discs in the box (*see also* "Regulations for Magazines, &c."), by having the fly nut screwed down upon it.

Around the top of the box, under the lid, sheet felt is secured with shellac and tacks, to make a tight joint.

On top of the lid there are two metal plates, each having a folding-down handle for lifting purposes, secured by screws; there is also a recess to contain a label of instructions.

The interior of the box is coated with paraffin wax, and the exterior is painted lead colour.

For dimensions, *see* Plate.

Box, Obturating, Pads and Discs, B.L. 8-in. and 9.2-in., Marks VIII and IX Guns.—Mark III is similar to the Mark III above described, but differing in dimensions, for which *see* Plate. It holds 3 pads and 3 sets of discs.

Box, Obturator, Steep-coned, B.L. 9·2-in., Marks X and XV Guns.
 —The box, Mark I, is of gunmetal; the top has a flanged shoulder, to take the cover. A steel bolt passes up through the box, and a gunmetal nut on the bolt screws down on to the cover, thus compressing the contents. The box holds an obturator and one adjusting disc; it is of the form and dimensions shown in the Plate.

IMPLEMENTS.

Description.	Land Service. Marks of Gun for which used.
Bit, vent, 36-inch	All Marks.
Borer, tube, chamber { square end	All the Marks using cordite charges.
{ pointed end	
Extractor, tube, special, box, slide A.. .. .	X and XV.
Lever, extractor.. .. .	IX.
Ordnance, B.L.—	
Bolt, eye { carrier, hinge bolt	X and XV.
{ hinge bolt, carrier ring.. .. .	
{ worm, carrier ring	IX.
Lever, extractor.. .. .	
Wrenches—	
Breech mechanism	IX.
" " { A	X and XV.
{ B	
" " { E	I to VIc.
{ H	IX.
Firing " { *K	X and XV.
{ L	I to VIc.
{ nut vent	I to VIc.
Nut vent	IX.
Rimers, vent, axial—	
Long	For guns using cordite vent primers.
Short, Mark IV	
Wrench, stud and screw, No. 1	All Marks.
	I to VIc.

* Also nut vent for 9·2-inch, Marks X and XV.

SIDE ARMS, &c.

Description.	9·2-in. Land Service. Marks of Gun for which used.
Brush, piassaba, bore, B.L. 9·2-inch, Mark II ..	All the Marks.
Brush, rammer, and sponge, B.L. 9·2-inch, chamber	*IX to XV.
Extractor, cartridge, B.L. 10-inch to 8-inch ..	All the Marks.
Extractors, drill shell { No. 2	All the Marks, except Mark IX on Mark III carriage.
{ No. 3	
(see also page 96)	IX on Mark III barbette carriage.
Rammer and sponge, B.L. 9·2-inch	I to VIc.
Rammer, B.L. 9·2 inch.. .. .	IX to XV.
Scraper, B.L. ordnance, 6-inch upwards ..	I to VIc (with powder charges).
Staves { end, B.L. 10-inch and 9·2-inch bore	All the Marks, for lengthening brush staves.
{ intermediate, B.L. 9·2-inch	
	IX to XV.

* Not yet settled for Mark IX gun.

CARE AND PRESERVATION OF ORDNANCE AND FITTINGS, AND AIMING RIFLE.

See "*Regulations for Magazines and the Preservation of
Artillery Matériel.*"

*RIFLE, AIMING, 1-INCH, MORRIS, B.L., MARK I.

This apparatus is for use with the gun in imparting instruction in laying, and consists of the following parts:—

Rifle, aiming, 1-inch, Morris, B.L.—

Barrel, 1-inch	..	..	Steel, with two washers, collar, set screw, and spiral spring.
Breech-piece	..	..	Steel, in two parts, with set screw, handle, two heads (one electric and one percussion), two extractor clips, striker, and spiral spring.
Block, retaining, electric, needle			Steel, with guide bolt, head, keep pin, and spiral spring.
Discs, extracting	..	..	Steel (10 to a set).
Frame, expanding†	..	..	Bronze, in two parts, with expanding screw, two washers, and two nuts.
Needle	{	electric† ..	.. Steel, with plunger, spiral spring, head, and securing nut and terminal.
		percussion†	.. Steel, with head, spiral spring, and securing nut.
Tube, 0.23-inch "E"	..	..	Steel, with nut and washer; rifle, aiming, 1-inch, Morris, B.L.

Implements used.

Rifle, aiming, 1-inch, Morris, B.L.—

Brush, cleaning	..	..	Without rod..	..	1
Rod, cleaning	..	..	Wood..	..	1
Tommy	..	..	Steel ..	..	1
Wrenches	{	breech-piece	..	Steel ..	.. 1
		discs, extracting	..	Steel ..	.. 1
		expanding	..	Steel ..	.. 1
		needle	..	Steel ..	.. 1

Tube, aiming, 0.23-inch—

Brush, cleaning	..	..	Without rod..	..	1
Rod, cleaning	..	..	Steel ..	..	1

* For Marks I to VI^c guns. Aiming rifles for Marks IX to XV guns are not yet settled.

† Special to Mark I gun, and Marks IV and VI^c guns.

The 1-inch barrel is $35\frac{1}{2}$ inches long, chambered and rifled on the Henry principle, having 11 grooves with a twist of one turn in 60 inches in Mark I barrel, and one turn in 35 inches in Mark II; the length of rifling is $31\frac{1}{2}$ inches. A steel breech-piece is fitted to the rear end of the barrel, which is provided at the front end with a screw thread having three interruptions cut upon it; the interior of the barrel being prepared in a similar manner admits of the breech being closed and the breech-piece locked in position by the sixth of a turn.

The breech-piece is in two parts, secured by a screw thread and set screw, and is furnished on the exterior with a sliding collar, provided with two handles, to facilitate insertion and withdrawal. The rear portion is furnished with a striker and spiral spring, and the front portion prepared for the reception of two heads (one for electric and one for percussion firing), through the centre of either of which the point of the striker passes. Extracting clips, which engage with the base of the cartridge case, are fitted to the front portion of the breech-piece for extracting the cartridge case when the breech-piece is withdrawn.

Fitted to the exterior of the barrel is a bronze frame, furnished with an expanding screw and nut for securing it in the chamber of the gun. The frame is furnished with a steel feather, which engages with a longitudinal recess on the barrel, and forms a guide for the barrel when in position. A spiral spring (acting as a buffer) and two washers are fitted over the barrel at the rear of expanding frame. A steel collar screwed over the barrel at the muzzle and secured by a set screw forms a stop, and serves to prevent the barrel being withdrawn from the expanding frame when in the gun.

The rifle is fired by means of the firing mechanism of the gun, for which purpose two steel needles are provided (one for electric and one for percussion firing). The needles (which are furnished with heads similar in form to the vent-sealing tubes used with the guns) are intended to pass through the vent channel of the gun, and make contact with the outer end of the striker. The electric needle differs from that for percussion firing in being insulated and furnished with a lead, which is placed over the terminal of the lock. The needles vary in length, to correspond with the length of the vent channel of the gun in which they are intended to be used.

The 0.23-inch aiming tube "E" is of special pattern. It is furnished with brass collars, which fit the bore of the 1-inch barrel, and is secured by a nut and washer at the muzzle.

Method of Fitting and Using the Apparatus.

The screwed collar is removed from the muzzle end of the 1-inch barrel, and the spiral spring, washers, and expanding frame placed over the barrel from the muzzle; the screwed collar is then replaced and secured by the set screw. The apparatus is placed in the chamber of the gun in such a position as will admit of the outer end of the breech-piece engaging with the inner end of the axial vent of the gun when the breech is closed. The bronze frame is expanded so as to secure the apparatus in the chamber by turning the expanding screw to the right by means of the wrench provided for the purpose; the axes of the gun and 1-inch barrel will then coincide.

When the breech of the gun is closed, the electric or percussion needle will be placed in the vent channel. The apparatus can then be fired by the firing mechanism of the gun.

Elevation is obtained by means of the gun sights, and any error in line will be corrected by use of the deflection scale.

It has been decided to fit an anti-fouling cylinder to the rifle. The arrangement for existing rifles consists of a 6-pr. Q.F. brass cartridge case, the base of which is bored out and screw threaded to fit on to a steel adapter fitted on to the barrel of rifle at the muzzle, the adapter being secured by set screws. But for aiming rifles of future manufacture, an anti-fouling brass cylinder will be used; the cylinder is screwed and sweated on to a steel adapter and further secured by three screws, the adapter being attached to the muzzle of the rifle by three set screws.

The 0.23-inch aiming tube E is placed in the 1-inch barrel (from the breech), and secured at the muzzle end by a nut and washer.

NOTE.—When the aiming rifle is used in guns mounted on Marks III, IV, and V barbette carriages, which are fitted with automatic sights, to give increased practice in laying with the sights, the ordinary cam of the automatic sights will be substituted by a cam cut to the range limit of the aiming rifle.

Care and Preservation.

All actions and parts of the rifle and tube should be kept perfectly clean and oiled, so as to keep them in good working order and prevent rust. No cutting material, such as emery cloth, is to be used for cleaning.

Ammunition used, see pages 90, 91.

CARRIAGES AND SLIDES.

Description.	Elevation in degrees.	Depres- sion in degrees.	Height of axis of trunnions above the racer in firing position.	Weight.		Diameter of trucks.		Radius of racers.	
				Carriage.	Slide.	Front.	Rear.	Front.	Rear.
			ft. ins.	tons. cwt.	tons. cwt.	ins.	ins.	ft. ins.	ft. in.
Carriage, garrison, B.L., 9·2-in.—									
Barbette { Mark I }	15	6½	..	11 4					
Barbette { " IA }	17	5	..	11 3					
Barbette { " IB }	15	10	5 6·5	19 8*	..	} Roller ring		4 4	4 4
Barbette { " II }	15	20	5 11·5	26 3*	..				
Barbette { " III }	15	10	6 11·4	74 17½*	..				
Slides, L., B.L., 9·2 inch—									
Barbette { Mark I .. .. . }	..	..	9 2	..	10 9½	greatest 24·674	24·674	5 11·13	5 11·13
Barbette { " IA .. .. . }	..	..	9 8·5	..	45 11	18	18	10 10	10 10
Barbette { " IB .. .. . }	..	..					
Barbette { " II .. .. . }	..	..					
Carriages, garrison, B.L., 9·2-in.									
Disappearing { Mark I }	15	5	14 3·5	50 5½	..	Roller ring		5 6	5 6
Disappearing { " II }	15	5	14 6	43 18	..	" "		13 6	13 6

* Weight of carriage on racer.

NOTE.—For *Special Implements* used with the above mountings, see Equipment Regulations.

*CARRIAGE, GARRISON, BARBETTE, B.L., 9-2-INCH.
MARK I.

For slide, *barbette*, Mark I, page 53.

(Plate XII.)

The mounting is constructed to fire "en barbette" over a 7 feet 6 inches parapet; it allows a recoil of 52 inches. Weights, &c., see p. 27.

The carriage consists of two steel double-plate brackets connected by front and rear transoms,† of the same material, and mounted on 10 steel "Rollers, carriage, No. 8," bushed with phosphor bronze. It is fitted with a shield‡; an hydraulic buffer in tension, which recoils with the carriage, to control recoil; frictional elevating gear; and a running-back pump for use at drill, &c.

Buffer, Hydraulic.

(Plate XIII.)

The cylinder A is of forged steel, and is fixed to the carriage. The piston rod B passes through the front of the cylinder, and is attached to the front of the slide. It is fitted at the rear with a piston, having a manganese bronze ring fitted round its periphery to prevent seizure, and it contains a rotating valve C. The cylinder is fitted with a filling plug D, and a drain plug E.

A controlling ram, EE, is fitted to the rear cap of the cylinder.

Piston Valve.

The piston is fitted with a gunmetal rotating valve C, with two ribs (H), which fit into rifled grooves L, in the cylinder. Ports (J) are cut in the piston, and a corresponding port K is cut in the valve.

Action.

When the carriage is in firing position, the port is full open. As the carriage recoils, the valve C is rotated by the ribs H sliding in the rifled grooves L in the cylinder, thus gradually closing the port until it is completely closed, when the carriage is at extreme recoil. The resistance thus offered to the passage of the liquid through the port is sufficient to overcome the energy of recoil in a length of travel of 52 inches. The pitch of rifling and the form of the openings are so arranged that the velocity of the liquid through the port is the same at any position, thus causing a uniform pressure in the cylinder during recoil, and reducing to a minimum the strain upon the pivot and foundations.

As the carriage returns into the firing position, the controlling ram EE enters the hole in the rear end of the piston rod, and displaces the liquid which has passed into the hole, when the carriage was at extreme recoil. The clearance between the ram and the hole

* Formerly called Elswick barbette mounting.

† When a Mark IV gun is mounted in this carriage, or in other cases where it is found the arc can run out of gear, a stop must be fitted to the front transom to prevent the elevating gear becoming disengaged from the arc, and to limit the depression to $6\frac{1}{2}^{\circ}$.

‡ The latest pattern is straight instead of curved as formerly. 1

is so small that a considerable resistance is offered to the motion of the gun and carriage, and thus they are prevented from running out violently against the front buffers of the slide.

Running back Pump.

(Plate XII.)

The running back pump is for drill purposes only. The bye-pass valve, worked from the wheel near the pump handles, must be closed before commencing to pump the carriage back, and opened to run it up. Before firing, particular care must be taken to close this valve to prevent the air which gets into the hydraulic buffers being forced into the tank on running up, and so causing an overflow. If the carriage does not run up completely, owing to air in the buffers, this valve should be opened to release the air gently, and closed again before firing; and to prevent the spindle of the valve being unscrewed too far, a metal collar is fitted to the spindle so as to admit of about two turns being given to it.

The pump (C) is worked by the handles (D) which, by means of a crank acting on the plungers, forces the liquid into the hydraulic buffer, and the pressure acting upon the piston, runs the carriage back; when the carriage runs up, the liquid is forced back again from the hydraulic buffer into the tank.

Elevating Gear.

(Plate XIII.)

The elevating gear is fitted on the right side of the carriage, and consists of toothed gear, actuated by a handwheel A.

The handwheel is fixed on the spindle E, which is carried by a brass casing which covers the gear, and has a pinion formed on it. This pinion engages the spur wheel D, which is carried on the spindle C, and is free to rotate on it. On the inner extremity is fixed a pinion B which engages the arc on the gun. The gear is provided with a compressor friction clamp, which acts in the following manner:—The steel friction rings are attached to and rotate with the spindle C. They engage alternately similar rings of gunmetal, which are keyed to and rotate with the spur wheel D.

These rings are pressed together by the nut I. The pressure on the spring disc H is adjusted by the nut I, so that the friction between the rings is sufficient to elevate or depress the gun, but will allow the gun to move without giving motion to the whole of the gear when any great strain comes on it, such as occurs when the gun is fired.

Elevation Indicator.—The angle of elevation is indicated by a disc (AA) (Plate XII) keyed to a small pinion spindle which is actuated by a toothed piece B, fixed to the elevating arc.

To Adjust the Friction of Elevating Gear.

Slacken the nut I, then screw it up gently against the disc H until the gun just moves when the handwheel A is turned. Great care should be taken not to tighten the clamp more than necessary, otherwise it will be of no effect.

Mounting the Carriage.

Remove the front and rear clips from the inside of the carriage, and draw the outside front clips out to clear the flange on the slide. Then lower the carriage (with piston rod) gently on to the slide, bolt on the clips, and secure the piston rod to the slide.

CARRIAGE, GARRISON, BARBETTE, B.L., 9·2-INCH,
MARK IA.

For slide, *barbette*, Mark IA, page 54.

This carriage differs from Mark I in being slightly wider between the brackets to take the Mark I guns.

The pivot of the elevating arc is fixed in the bronze counterweight and not in the metal of the gun as in the later Marks, as the distance behind the trunnions in the Mark I gun is shorter, and the bronze counterweight itself takes up a considerable part of that distance.

CARRIAGE, GARRISON, BARBETTE, B.L., 9·2-INCH,
MARK IB.

For slide, *barbette*, Mark IB, page 54.

Only one mounting of this description has been made for Mark I guns; it differs from Mark IA in having been furnished with a straight shield at manufacture.

* CARRIAGE, GARRISON, BARBETTE, B.L., 9·2-INCH,
MARK II.

For slide, *barbette*, Mark II, page 54.

(*Plates XIV and XV.*)

This mounting is constructed to fire "en barbette" over an 8 feet parapet, and to allow a recoil of 8 feet. Weights, &c., *see* p. 27.

The carriage is fitted with two hydraulic buffers in tension to control recoil, and with 14 rollers to ensure its automatically "running up" immediately after firing; provision is also made for running the carriage back by means of a pump, which is used for drill purposes only.

The carriage consists of two cast-steel bracket sides, connected by a transom of similar material, to which they are fixed by dovetailed joints and steel bolts.

The brackets are each cast with ribs to increase the strength; with deep trunnion bearings to dispense with capsquares; and with pockets for the rollers.

* Mark II mounting was originally called "R.C.D." barbette mounting.

Each bracket is bored out to take a steel cylinder for the hydraulic buffer, which is closed at each end with a steel cap. The front cap is fitted with a steel stuffing box, and with a metal gland for tightening the packing round the piston rod.

The buffers are designed to give an approximately constant pressure during recoil. For this purpose they are fitted with taper bars and apertures in the pistons, which can be altered in area, by turning the piston rods; the resistance of the buffers is thus adjusted to suit varying charges.

The piston rods are turned by means of a connecting bar, which is attached to their front ends by short levers; and a graduated scale is fitted on the front of the slide to indicate the amount of adjustment.

The cylinders are connected by a copper tube so that the quantity of fluid will always be the same in each buffer, to ensure equal pressure in both. A phosphor bronze plunger is fixed to the rear cap and enters a cylindrical hole in the piston rod. The hole being slightly larger than the plunger, the arrangement acts like a small hydraulic buffer, to prevent violent concussion when running up.

The rollers are of steel, bushed with phosphor bronze, and revolve on steel axles, which are kept in position by iron plates (*a*), screwed to the carriage sides. Eight "Rollers, carriage, No. 22," two at each corner of the carriage, are flanged on the inner side to serve as guides to the carriage; six "Rollers, carriage, No. 21," being placed at intermediate points between the front and rear sets. By removing the plates (*a*) the axles and rollers can be taken out for cleaning, &c., without lifting the carriage.

Rear clips cast on the inner side of the bracket sides, and steel front clips bolted on at (*b*), keep the carriage on the slide when firing.

The running back gear consists of a double acting pump in a cast-iron cistern (*W*) connected to the buffer by means of a copper pipe, coupled to the hole for the right filling plug; the pump is hung on the right carriage bracket by two iron clip hooks, and is worked from the ground by means of a double handed lever (*g*) with stop to regulate the length of the stroke. The releasing valve is worked from the bottom of the cistern by a hand wheel, and a draw-off cock is provided for emptying the cistern; a portable derrick with chain and block is fitted to the top of the carriage bracket for use when attaching and removing the pump.

Elevating Gear.

The elevating gear is on the right side of the mounting, and is actuated by a hand-wheel (*A*), on the first motion shaft (*B*), which carries a bevel pinion gearing with another bevel pinion on the end of the second motion shaft (*C*); this shaft has a featherway between centre and rear brackets for gearing and revolving a bevel pinion on the shaft. These shafts are supported in suitable brackets and bearings on the side of the slide.

Secured to the side of the carriage is a bracket (*D*), which slides on the second motion shaft and supports, vertically, the third motion shaft (*E*), fitted with a bevel pinion on its lower end, which gears with the one on the second motion shaft, and a spur wheel on its upper end gearing with another spur wheel on the vertical worm shaft (*F*), the worm of which drives the worm wheel (*G*) working on a spindle; on the inner end of this spindle is the arc pinion which

gears with the teeth on the front of the arc (H), secured to the gun. A certain amount of slip is allowed to the gear by the friction cones of the worm wheel.

The arc is secured to the elevating band on the gun by two steel pivots.

The upper half of the arc is furnished with teeth to gear with the arc pinion, on the lower half the teeth are cut with a smaller pitch to suit the pinion on the shaft of the elevation indicator.

The gear is secured to the carriage by suitable brackets; the spur wheels on the third motion and worm shafts are covered by a steel guard, and the worm wheel by a metal one.

Elevation Indicator Gear.

A graduated metal disc (I) is secured to the side of the carriage in front of the elevating gear, elevation is recorded upon it by an aluminium pointer (J) on the end of a spindle which passes through the disc, the spindle is actuated by a pinion in gear with the elevating arc.

CARRIAGE, GARRISON, BARBETTE, B.L., 9.2 INCH, MARK III.

(Plates XVI to XVIIIa.)

This mounting is constructed to fire "en barbette" over a 6½ feet parapet. It allows a recoil of 3½ feet, and generally consists of carriage and slide with hydraulic buffers, sighting platforms, gears elevating, traversing, elevation indicator, and loading; roller ring; electric firing gear, pedestal, holdfast, racer, and traversing arc.

To mount the gun, &c., see page 67. Weights, &c., see p. 27.

Carriage.

The carriage consists of two cast-steel brackets (a), each having an opening for the reception of an hydraulic buffer. The brackets are grooved on the underside, and lined with manganese bronze where they bear against the slide. Clips are bolted to each side of the recess to engage with the upper flanges of the slide when the carriage is mounted. Trunnion bearings are formed in the upper sides of the brackets, in which the gun is secured by sliding metal capsquares, with keys. A bracket (b) is formed on each side under the trunnion bearings, to receive the nuts in which work the adjusting screws (c) of the ball bearings.

Ball Bearings.—These are intended to decrease the friction in elevating; they are fitted on the outside of each trunnion and carriage bracket. A false trunnion is screwed into the end of each trunnion of the gun, part of the false trunnion is octagonal-shaped to take the ball bearings, which consist of an inner and outer ring, fitted vertically over each other, each having a groove, so that when in position they form a path for the hardened steel balls; the ball-bearing surfaces of these rings are thin hard steel rings let into the main rings; the inner ring fits over the octagon of the false trunnion, and to prevent the bearings falling off it, a screw passes through a lug on the outer rings and into the carriage brackets. The bearings

are adjusted by a vertical screw and nut, supported in the bracket (b); stout disc springs are placed on the screw, which then fit into a socket formed on the outer ring of the bearings. When the gun is elevated or depressed the inner ring and balls revolve together. When the gun is fired the disc springs are compressed, and the gun trunnions take a bearing in the trunnion holes, after which the springs expand, when the weight of the gun falls on the ball bearings.

To Adjust the Bearings.—Turn the adjusting screw in the required direction, and at the same time move the elevating gear by the hand-wheels until the gear works easily, then secure by the set screws.

Hydraulic Buffers.

The buffers are in tension and designed to give an approximately constant pressure during recoil.

The cylinders are of steel, and placed in the openings in the carriage brackets from the rear, secured by a projection on the rear of each cylinder fitting into a groove in the opening, and a metal ring screwed on the front of the cylinders has a bearing against the carriage bracket opening. A metal stuffing box is secured into the front of the cylinder; a leather packing is placed in the stuffing box, and is kept in position by an inner packing gland, the latter is recessed to take a metal ring and cotton packing, screwed up by an outer metal gland. Each cylinder has a metal valve key or equalising strip fitted along the inside to fit the port of the piston; there is a filling hole on top near the rear, which is closed by a screw plug, and in front of this hole on the inside of the cylinder is a small groove which admits of any air which may have accumulated in the cylinder to escape over the piston; a draw-off valve is provided on the outside near the front, which is closed by a screw plug; and the cylinders are connected by a steel pipe (having a metal nozzle and coupling at each end) near the front, so that each may have an equal quantity of fluid.

The piston and rod are of steel, a manganese bronze ring is fitted round the piston to prevent scoring; a port for the valve key and passage of the oil is cut through the piston. A hole is bored in the rear end of the piston rod for the controlling ram. The front ends of the piston rods are connected by nuts to cast-steel brackets bolted on the front of each girder of the slide.

The rear of the buffer is closed by a metal cap screwed into it, and the controlling ram with adjustable plug is bolted in the cap. This controlling ram is of manganese bronze; it is hollow, and a small hole is bored through it near the rear end for the liquid to escape as the carriage runs up; the size of the central hole in the ram can be regulated by a small screw valve fitted to the end of the ram.

For contents of buffers, see page 68.

Action.—Both buffers are filled with oil, and on recoil the cylinders are drawn off the piston rods, the oil passing from front to rear of the piston, through the port; the equalising strip in the cylinder fits into the port of the piston, and so gives a uniform recoil. The slide has sufficient slope to enable the carriage to run up after recoil, the controlling ram preventing it running up too violently.

NOTE.—For running back at drill, &c., a pump is used; for description, see page 79.

Elevating Gear.

The elevating gear is fitted on the left side. The arc is secured to the elevating band on the gun, and gears with an arc pinion on a shaft which passes through the bracket of the carriage; this shaft has a worm wheel on its outer end, driven by a vertical worm shaft, having a bevel pinion on its lower end, gearing with another bevel pinion (the shaft and pinions are supported by a bracket fixed to the carriage) sliding on a longitudinal shaft, revolved by having a feather fitting into a featherway on the shaft. The longitudinal shaft is supported, in front, rear, and centre, on the side of the slide; and it is actuated by further wheels and shafts and hand wheel *z* in front, and *z'* on the sighting platform, as required, the former being quick motion gear and the latter slow.

Slide.

The slide consists of two built up girder sides (*d*), formed of plates and angle steel rivetted together, connected by three transoms and a centre bottom plate, and also by two box-shaped transoms (*e*), one under the front of the slide, and the other under the rear, and these are connected by two semi-circular pieces of angle steel, one each side.

The upper roller path (*f*) in two segments is fixed to the under side of the box-transoms. A cast-steel bracket (*g*) is bolted to the front of each girder, and has a lug formed on the upper side for the attachment of the piston rods of the hydraulic buffers. The slide is fitted with part of the elevating gear; traversing gear; holding-down clips; sighting gear; loading gear; two laying platforms, with ladders; and a shield. The slide has a slope of 9 degrees.

Traversing Gear.

The slide is supported and traversed on a live-roller ring, which consists of two concentric steel rings, connected by collar rivets, and furnished with metal bushed holes for the axles, the latter being secured in the rings; the roller ring carries 16 "Rollers, carriage, No. 18" (*h*) of steel, metal bushed, flanged on both sides, and coned to suit the pivot. The slide is prevented from lifting by a holding-down clip casing (*i*), front and rear, which hook under a clip ring formed on the racer. The traversing gear can be worked by three hand wheels, two on the sighting platform in rear, and one on the left side in front; the front and rear motions are used separately, as required, the front gear being quick motion and the rear slow.

The gear consists of a train of wheels and shafts, motion being given to a vertical shaft at the front of the slide, on which is a pinion gearing with a rack round the outer edge of the racer.

Sighting Gear.

Automatic Sights (Plate XVIII).—This gear is on the left side of the mounting, and is supported on the side of the carriage by "Bracket, sliding, sighting gear" (*A*), and on the slide by "Bracket, supporting sight, left" (*B*). The frame (*C*) carrying the sights is elevated or depressed by the action of the cam roller upon the cam (*K*) through a system of crank gear, made up of the cam bracket (*D*), cam roller lever (*E*), link for cam roller lever (*F*), square shaft (*G*), square shaft lever (*H*), front connecting rod (*I*), and trunnion stud lever (*J*); the latter is fixed to the gun trunnion, and so

actuates the gear. The roller is kept to its work by the spiral spring and spindle (L); the cam is also kept up to the roller by the retaining clip (M), which is fixed to the frame, and whose bent point clips the flange of the cam. One end of the cam is attached to its bracket and adjusted by an eccentric lever (N) in connection with a graduated arc (O), the other end of the cam is attached to the bracket by a screw working in an adjusting nut (P), whose frame also carries a packing piece, which can be reduced to give final adjustment. There is a separate cam for the full and $\frac{3}{4}$ charges, and these cams are substituted by one cut to the range limit of the 1-inch aiming rifle when required, so as to afford increased practice in laying with these sights.

An error of day adjustment drum (Q), having a scale of yards over and yards short, with reader, is fixed over the sight frame by means of a stirrup attached to the cam roller lever. (*See* also auto-sights, page 40.)

A steel pillar is fitted into the front end of the frame; it has a feather to fit a featherway in the frame to prevent it turning, and it is secured in the frame by a clamping screw; the top of the pillar is recessed to take a foresight, which is the same as for the Mark IV mounting, page 41.

The rear end of the frame is fitted similarly to the fore-sight with a steel pillar, with cross-head having a sliding leaf with reader fitted on its rear face, traversed by a brass screw with milled heads; a scale plate graduated to 2 degrees left and right is fitted on the rear face of the cross-head.

The top of the frame may be used as a plane for clinometer.

A telescope sight is also used with this gear; to use it the before mentioned front and rear pillars are removed from the frame, the rear one being substituted by a pillar supporting telescope. This pillar has a cross-head which admits of a horizontal movement of the carrier giving deflection in a similar way to that of the auto-sight of Mark V barquette carriage, page 49.

Care and preservation, *see* page 67.

An adjustable shoulder piece is now approved for use with this sight.

Rocking-bar Sights.—This gear is on the right side of the mounting. The frame for the sights is actuated, and furnished with a fore-sight, as for the automatic sights. The rear end of the frame is fitted with a hind sight arrangement similar to that for the Mark IV mounting, page 40; but the cross-head, deflection leaf with reader, and scale plate, are as for the automatic sight on the left side, above mentioned, when without telescope, and the range strip for the $\frac{3}{4}$ charge is graduated to 11,700 yards instead of 11,800 yards.

Elevation Indicator Gear.

This gear is attached to the left side of the mounting, convenient to the front elevating hand wheel. A metal "arc segment, upper" is fitted on the front end of the automatic sighting shaft, secured by a collar and nut; it has teeth to gear with a steel "arc segment, lower," which works on a pin supported in bearings, in the front bracket of the gear; a steel pointer is attached to the latter sector, and works along a graduated plate fixed to the top of the bracket. A strong spiral spring is wound round the axis pin of the steel sector, one end being secured to the pin, the other to a stud on the sector; its use is to prevent back lash.

Loading Gear.

A forked lifting arm (*j*) is pivoted inside the sides of the slide at the rear, and has at its lower end a steel carrier (*k*) with metal loading tray; the latter is free to slide on three rollers in the carrier, so that it can be pushed forward into the gun to protect the threads of the breech screw, a spring which engages a slot in the tray prevents it being pushed out of the carrier, the spring is disengaged, when required, by means of a small cam lever. A steel arc (*l*) is attached to the right arm of the fork into which gears a pinion on the inner end of a spindle, supported in bearings in a bracket, bolted to the right side of the slide; on the outer end of this spindle there is a spur wheel worked by a pinion and winch handle. A notch is cut in the inner side of the arc to take a pawl to hold the arm in the loading position, the pawl is fitted with a handle. To assist in raising the projectile, a cast-iron counterweight (*m*) is suspended by two steel cords, which pass over pulleys on the rear holding-down clip, and the upper end of each cord is attached to the upper arms of the fork. When the bearer with tray is vertical or in a position to receive the projectile, the cords pass under the pivots of the lifting arm, and have a tendency to retain the arm down; but as soon as the gear is worked sufficiently to bring the cords above the pivots, the counterweight drops and helps in raising the weight. The gun is loaded at 15 degrees elevation; a stop is fitted to the side of the carriage to prevent the arm, raising projectiles, fouling the cross-shaft of the traversing gear; a bracket with wood block fitted to the arm forms a stop for the breech in that position; a stop (*n*) is also fitted to the front of the arm to bring the carrier vertical to receive the projectile. Foot rests are fitted to each side of the arm, so that a man can be raised by the gear to place a tube in the vent.

Shield.

The shield is of steel, with an opening in the front to allow 15 degrees elevation and 10 degrees depression being given to the gun; it has also two smaller openings in the roof for sighting purposes. The shield rests upon, and is attached to stays, the latter being bolted to the slide.

**Electric Battery and Firing Key.*

The "Battery and key, test and firing," is fitted on either side, to the front of the mounting. A bracket is attached to the pedestals carrying gear, for the firing key, which can be used from the sighting platform on either side of the mounting, as required. See also page 72, and for electric cables used, see Equipment Regulations.

The following traversing arc, holdfast, pedestal, and racer, are used with this carriage:—

ARC, TRAVERSING, No. 34.

Mark I: this arc is of brass made in two ring sections, each being in lengths, the degree figures are engraved upon the upper section, and the division and sub-divisions on the lower one. It is secured round the outer face of racer below the clip ring; the angle of traverse is indicated by a pointer fixed to the slide.

* Firing gear similar to that used with Mark V barbette carriage (page 51) is under consideration.

HOLDFAST, CARRIAGE PEDESTAL, NO. 4A.

Mark I holdfast is of steel and consists of 13 anchoring plates, and 52 holding-down bolts which are 9 feet 11 inches long, each having a cotter, the bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

Weight 4 tons 10 cwt.

PEDESTAL, CARRIAGE, NO. 4.

Mark I pedestal consists of two semicircular castings (O), Plate XVI, with two joint plates and bolts, secured together when in position. It is formed with a flange at the bottom, which is bored for the holding-down bolts of the holdfast, while the top is prepared the racer.

Weight 17 tons 17 cwt. 3 qrs.

RACER, CARRIAGE, GARRISON, BARBETTE, MARK III, B.L., 9-2-INCH.

Mark I racer is of steel, bolted on the top of the pedestal by bolts on each side of racer, 30 on the outside and 16 on the inside of it. A clip ring or flange is formed on the outer face, to engage the holding-down clips of the carriage; and a traversing rack is bolted on above the clip flange.

Weight 3 tons 0 cwt. 2 qrs. (complete).

CARRIAGE, GARRISON, BARBETTE, B.L., 9-2-INCH,
MARK IV (FOR MARK IX GUN).

(Plates XIX to XXI_B).

The mounting is constructed to fire "en barbette" from an elevated emplacement. The gun recoils axially about 3 feet 6 inches, extreme 3 feet 9 inches, in a steel cradle (A), which is fitted with an hydraulic buffer to control the recoil, and an air chamber to return the gun to the firing position; the cradle is mounted on a steel carriage (B), which is revolved on a live roller ring upon an iron pedestal (C).

For weights, &c., see table, page 27.

To mount the carriage, gun, &c., see page 68.

Connecting Band and Sliding Blocks.

(Plate XXI_B.)

The gun trunnions fit into a pair of steel "blocks, sliding," which are H section, connected in front by "band, connecting, gun and buffer." This band is secured to the gun in front of the trunnions, and to the sliding blocks by a rectangular projection on either side of the band, fitting into a corresponding recess in the blocks; the band and blocks are fitted to one another by eight steel screws on either side. The lower part of the band has a circular hole which passes over, and is fixed to the buffer cylinder: thus the gun, band, sliding blocks, and buffer cylinder recoil together.

Cradle.

(Plate XXII.)

The cradle consists of two guides secured at each end by a transom bracket, the front bracket carries the buffer piston rod and the rear the air chamber. It is provided with trunnions, having ball bearings as for the Mark III mounting, the adjusting screws and spring discs are on the carriage; and an elevating arc is fixed on each side of the cradle.

Hydraulic Buffer, Air Chamber, &c.

(Plate XXIII.)

The principal parts of these are:—Cylinder (*b*), piston (*c*), piston rod (*d*), with controlling ram (*l*), air chamber (*f*), intensifier (*g*), and air pump (*h*). The cylinder, piston, and rod, are of steel; the air chamber, &c., of manganese bronze.

The buffer cylinder which forms also the ram of the air chamber, is held at the front end by the gun band, and is prevented from turning by a steel feather, a steel securing collar screws on to the large gland in front of gun band, where it is held by a set screw; the cylinder is sheathed with metal to prevent scoring; the front of the cylinder is closed by a large manganese bronze gland screwed in, in which is placed an L leather secured by a metal stuffing box containing .75-inch square section hydraulic packing, which is compressed by a small inner gland of manganese bronze which screws into the stuffing box.

Air chamber: the escape of air is prevented by the use of liquid in the gland, this liquid being supplied to the gland at a slightly higher pressure per square inch, than the air in the chamber. During recoil the entry of the ram compresses the air in the air chamber, and this air is used to restore the gun to the firing position. The return movement is controlled by a counter or controlling ram in the piston rod of the buffer, the resistance of which may be adjusted by a plug valve (*e*) on the axis of the rod. For charging the air chamber, an air pump is provided on the upper side of the chamber, having a copper connecting pipe (*i*); there is an attachment in rear of the air chamber for a pressure indicator.

The intensifier is for supplying liquid to the gland by means of a copper pipe (*j*). It consists of a cylinder, on the lower side of the air chamber, in which works a piston, with piston rod passing through a stuffing box, formed in the front end of the cylinder; the rear end is in communication with the air chamber. The cylinder will require filling when the piston rod of the intensifier is seen projecting about 3 inches; it is provided with a filling hole. To fill the cylinder, remove the plug from filling hole, place a funnel in the hole, a special clamp is used for pushing back the piston rod, this clamp consists of two tie-rods, two cross-pieces, and a compressing screw with lever, and on screwing up the clamp the fluid will be drawn into the cylinder. See also care and preservation, page 68.

Carriage.

The carriage consists of two sides built up of steel plates, to which are rivetted steel castings forming the trunnion bearings. The sides are braced together by transoms, and are fixed to the front and rear

bolsters or box transoms; sections of upper roller path are secured to the bolsters. The capsquares are of forged steel, and each one is secured by six screws. The carriage rests on a live roller ring, similar to that for the Mark III mounting, *see* page 34, and fitted with 16 steel "Rollers, carriage, No. 18"; the ring revolves on a racer attached to the pedestal. Steel clips, front and rear, secure the carriage to the lower roller path. A sighting platform is attached to the right hand side of the carriage, from which also elevating and traversing the gun can be effected. A pointer is fitted to each side of the mounting, for use with the traversing arc, which is bedded in concrete surrounding the pedestal. A standard bracket for the electric firing key is fixed on both brackets of the carriage, convenient for the gun layer; and supports are prepared on the front transom for the "Battery and key, test and firing,"* so that the gun may be fired electrically from either side. *See* also page 72, and for electric cables used, *see* Equipment Regulations.

Elevating Gear.

An elevating arc is attached to each side of the cradle, and actuated by worm wheel gear, the worm wheel has a friction clip clutch, formed by a series of alternate steel and metal plates. The gear is so arranged that it can be worked by hand wheels, either from the sighting platform on the right or from either side of the mounting at the ground level, the former being slow motion gear, and the latter quick.

Elevation Indicator Gear.

This gear is on the left side of the mounting and consists of an arc segment; spur pinion; spindle, with collar and nuts; spiral spring; steel pointer; graduated range dial; and bracket for spur pinion.

The arc segment is pivoted on the hexagonal end of the false trunnion of the cradle trunnion, its lower end is furnished with teeth which gear with the spur pinion. The gunmetal spur pinion bracket is fixed to the carriage, its outer end being in the form of a disc, and recessed on the outer face to take the range dial of aluminium, these are secured to each other by screws, locally. The spindle for the spur pinion, working in its bracket, passes through the range dial and carries the pointer which is secured by collar and nuts. To keep the spur pinion up to its work, or to prevent back lash a spiral spring is used, one end is passed over a stud on the pinion and the other end is attached to the spur pinion bracket by a screw.

Therefore, any movement of the gun in its cradle will actuate the pointer (by means of the segment and pinion), which will indicate the required elevation or depression on the dial connected to the carriage.

Traversing Gear.

Traversing is effected by the traversing pinions on the carriage engaging with the rack secured to the racer casting; the front pinion is actuated by bevel and spur gear, and a cross shaft passing through the sides of the carriage, near the front, this shaft has a hand wheel on each end worked at the ground level; or by an inclined shaft on left side gearing with a bevel wheel on the cross shaft, and driven by a hand wheel from the sighting platform; this latter is the slow

* Firing gear similar to that adopted for Mark V barbette carriage (page 51, but with two pistol grips instead of three, and of course two cables less) is under consideration.

motion gear of this section; there is a separate quick motion gear at the rear, right side, the rack pinion of which is actuated by shafting, spur, bevel gear, and a hand wheel worked from the sighting platform.

Sighting Gears.

Rocking-bar sights.—This gear is on the left side and fitted on the top of the cradle by means of "Bracket, supporting, rocking-bar sights, front and rear"; and consists of a steel rocking-bar fitted in the centre with a carrier pivoted to the front supporting bracket. The rear end of the rocking-bar is fitted to the rear supporting bracket, and furnished with a hind sight having a cross-head, fitted with a deflection nut and reader, traversed by a brass screw, furnished with milled heads. A scale plate of crown metal is attached to the rear face of the crosshead by two screws; it is graduated for two degrees right and left deflection, the deflection nut is of steel with a sighting notch .06 inch deep; a crown metal reader is attached to the rear face of the nut by two screws. Deflection is obtained by traversing the nut with reader till the point of the latter is over the required graduation on the scale plate. The lower portion of the sight consists of a sight-arc, fitted on the rear face with a removable range strip graduated to 15 degrees; the muzzle face of the arc is furnished with a rack which engages with a pinion actuated by worm and hand-wheels. Attached to the pinion spindle is a drum, having round the periphery a range strip graduated to 13,800 yards, for a full charge with M.V., or a drum with range strip graduated to 11,800 yards for three-quarter charge. To facilitate reading the yard scale, a steel reader is attached to the bracket worm-wheel. All scales and range strips are of aluminium.

The foresight is of steel, and consists of a holder, straight edge sighting blade, acorn for fine laying, adapter with adjusting and fixing screw. The acorn fits into a recess in the holder where it is secured by a screw. The blade is fitted on the holder and secured by an arm which passes through a hole in the holder, upon which fit a spiral spring and collar with taper pin, the object of the spiral spring being to allow the blade to be pulled outwards and folded down when not required in a vertical position. The holder fits into the adapter, and secured to it by a screw; the adapter is free to move in a recess in the rocking-bar, and prevented from turning by a feather on it, which fits into a featherway in the recess; the adapter is moved from below by an adjusting screw, fitted into the rocking-bar and clamped by a hexagon fixing screw, which passes through the adjusting nut into the adapter. The sight is in adjustment when screwed down home, and this should be regarded as the normal position of the foresight, correction being made only to suit the individual gun layer should time permit of the gun being carefully laid on a distant target.

Automatic sights.—Plate XXIA.—This gear is on the right side, and principally consists of a cam lever A; cam B; cam roller lever C, with axle and roller C¹; pivot bracket D; cam and cranked lever connecting rod E; spring and spindle in case F, with bracket F¹; bell cranked lever G; pivot and cranked lever connecting link H; sight-bar I, with foresight, telescope hindsight, and incandescent electric lamps.

The cam lever is fixed to the cradle trunnion, and with the cam moves with the gun, as the latter is elevated or depressed, the roller moving along the cam by means of the cam roller lever; the sight-

bar is moved also, but at a different speed to that of the gun, the spring spindle keeping the cam roller up to its work in the cam by the spindle being connected to the support of elevating gear and lower of cam roller.

The sight can be moved vertically only by elevating or depressing the gun, and the cam is so shaped that the angle between the axis of the gun and the line of sight is always equal to the proper angle of elevation for the range. From this, it will be seen that the cam must be cut to suit the height of the gun above the sea, and each cam will thus be special to the site for which it is made, and also for the full and $\frac{3}{4}$ charges, and these cams will be substituted by one cut to the range limit of the 1-inch aiming rifle, when required, so as to give increased practice in laying with these sights by using the rifle.

The sight-bar is pivoted in the centre to the cam roller lever, and secured by a screw pivot.

The foresight on the sight-bar is the same as that for the rocking-bar foresight, page 40.

The rear end of the sight-bar is fitted for the deflection nut of a cross-head, fitted and clamped by a clamping screw to the rear end of the cam roller lever; the deflection nut is fitted to slide in the cross-head, and is traversed by a brass screw with milled heads; a scale plate is fixed to the rear face of the cross-head, and graduated to 2 degrees deflection left and right; a reader is fixed to the deflection nut, and slides over the scale plate. The sight-bar being pivoted in the centre admits of deflection being given in the usual way.

The stem of the cross-head is fitted with a milled head metal "Nut, adjusting, error of day" having a scale round it, graduated in yards short and yards over, by its means the relative positions of the sight bar and the cam roller lever can be altered to the extent necessary to compensate for any error observed in the shooting. A telescope is fitted to the upper side of the sight-bar for use when laying on distant objects.

Care and preservation, *see* page 63.

An adjustable shoulder piece is now approved for use with this sight.

The following traversing arc, holdfast, pedestal, and racer, are used with this carriage:—

ARC, TRAVERSING, No. 33.

Mark I is made of metal, in three sections, each one being in segment lengths; the centre section has the divisions and subdivisions graduated upon it, and the other two the degree figures, thus admitting of the degrees of traverse being read by either the right or left pointer attached to the carriage (the inner figures with left pointer, and the outer figures with right pointer).

The arc is secured by steel screws to cast iron nuts, large nuts for the figures and small for the graduated division lengths, let into the emplacement.

Radius from centre of middle section of arc 5 feet 10 inches.

HOLDFAST, No. 4B.

Mark I: this is of steel, and consists of 13 anchoring plates, and 52 holding-down bolts, which are 6 feet 7 inches long; the bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

Weight 3 tons 13 cwt. 1 qr.

PEDESTAL, CARRIAGE, No. 4 (MARK I).

RACER, CARRIAGE, GARRISON, BARBETTE, MARK IV, B.L. 9.2-INCH
(MARK I).

The pedestal is identical, and the racer is similar, to those of Mark III, carriage, p. 37.

Weight of racer 3 tons 1 cwt. 3 qrs., complete.

LOADING ARRANGEMENTS FOR USE AT GIBRALTAR WITH THIS CARRIAGE.

The ammunition, carried by its trolley, is brought up by lift from the ammunition stores—two lifts are furnished so that there may be no interruption in the supply of ammunition. The lifts (with metal rails on top) form part of the circular railway, laid at a radius clear of that described by the breech of the gun, to enable the gun to be loaded at almost all degrees of traverse. Another line of rails, laid at a greater radius than the last mentioned, takes a loading platform which is moved round with the loading trolley.

Loading trolley.—This is an iron box with wood casing to take the two half-charges, side by side, in the direction of length of trolley; it is fitted with two axles and four railway trucks. On top a projectile metal carrier is pivoted, which can be turned through a half-circle, and clamped by a clamping lever, in the loading and fore and aft positions, it carries a metal tray to take the projectile, the tray is free to slide on three rollers in the carrier so that it can be pushed forward into the gun to protect the threads of the breech screw while loading, a spring on the carrier engages a slot in the tray, thus preventing it being pushed out of the carrier, the spring is disengaged by means of a small cam lever. A lever is hinged to the pivot bracket on the inner side of the trolley for attaching the trolley to the breech of the gun, the latter being elevated for this purpose.

Loading platform.—This is of iron, fitted underneath with four railway trucks on two bent axles to suit the different level of rails on the sloping ground, the inner ends of the axles have gunmetal rollers which fit under a bearing plate in the face of the emplacement to prevent the platform upsetting outwards; the inner corners are each fitted with a screw for clamping the platform to the work during loading; an iron handle is fixed near each end of the platform for use in moving it, and guard-irons are fixed on the outside.

CARRIAGE, GARRISON, BARBETTE, B.L. 9.2-INCH,
MARK V.

(Plates XXIIc to l.)

This mounting is constructed to fire *en barbette* from a pit emplacement, 28 feet in diameter and about $8\frac{3}{4}$ feet deep, and generally consists of a cradle with elevating and sighting gears; carriage with shields, loading, traversing, and indicator gears; pedestal with holdfast, pivot plate, and live roller ring.

The gun recoils axially in its cradle about 3 feet 6 inches, extreme 3 feet 8 inches.

For elevation, depression, weights, &c., see table p. 27.

To mount the carriage, gun, &c., see p. 69.

Bands and Sliding Bars.

The bands are front (A) and rear (B); the former is cast in three pieces and the latter in halves; they are bolted together after being placed in position on the gun. The front band is secured to the gun about the centre of gravity, and the rear band in its seating near the breech; the last named band is prevented from turning by a key on the gun. These bands have projections on their sides, where they join, upon which are fitted sliding bars (C); these bars are each 11 feet 11·8 inches long, each having an anti-friction metal bearing plate extending 5 feet from the front, the bars fit into corresponding sliding surfaces in the sides of the cradle.

There is a projection on the lower side of the front band which has a hole formed by the two lower castings for the cylinder of the hydraulic buffer, the castings are fixed together by screw bolts.

The gun, bands with sliding bars, and buffer cylinder recoil together.

Cradle.

This is of steel castings, and consists of two sides (D), 8 feet 10·7 inches long, prepared on the insides for the sliding bars attached to the gun bands, grooved to contain lubricating material, and connected at the ends by a front and a rear transom bracket. The front bracket has a hole for the reception of the piston rod of the hydraulic buffer, and the rear bracket is cast to take the air chamber, bronze anti-friction strips being let in on its upper hollow for the gun.

Ball bearings. *Plate XXIf.*—The cradle is provided with ball bearings in a manner somewhat similar to the Mark III barbetto mounting, p. 32. An anti-friction ball bearing is fitted on the outer end of each trunnion; each bearing consists of 24 hard steel balls, which work in a groove formed by two hard steel bevel rings secured by a metal adjusting nut screwed on to the trunnion, consequently these revolve with the cradle; over the balls is a steel band having on its inner circumference a hard steel bearing ring, which is let in and secured by a retaining steel ring and three screws on the inside face; there is a socket formed on the underside of the band for the supporting screw of ball bearing; this screw has a cylindrical head, to fit the socket just mentioned; below it is a hexagon shoulder to take a spanner, the lower part of the screw being threaded to screw into a corresponding hole in a projection on the carriage side; a pair of No. 46 spring discs is arranged on the cylindrical part of the screw to take the weight on firing. Movement of the cradle in its bearings is rendered easy by the adjustment of the supporting screws.

A steel elevating arc is bolted to the underside of each of the cradle sides, the arcs being connected and strengthened by a cross transom bar. Fitted to the front of the left arc is a metal arc for the elevation indicator gear.

The left trunnion is cast hollow and prepared for the elbow pipe of the hydraulic system, the hollow is continued along the side of the cradle to the rear, where it is connected to the recoil utilising cylinders of the hydraulic gear.

Hydraulic Buffer and Air Chamber.

Plate XXIf.

The hydraulic buffer (E) is in tension, the cylinder forming the ram of the air chamber; the piston rod and air chamber are secured

to the brackets of the cradle. The front band (A) takes the cylinder of the buffer, which is retained by a screw collar of steel screwed on to the front of the stuffing box, a steel feather let into the cylinder and band underneath prevents the cylinder turning in its housing. The rear bracket carries the air chamber, which is secured to it by two screws underneath and one on top. The piston rod is connected to the front bracket of the cradle by a screw collar in rear and a nut and keep pin in front.

The buffer admits of 3 feet 8 inches recoil, metal to metal, and will hold $9\frac{1}{2}$ gallons of liquid.

The *cylinder* is of steel, and is 5 feet 11 inches long and 14.4 inches diameter, over all, and is sheathed with gunmetal, to prevent scoring the bearings of the air chamber, the sheath being 5 feet 1 inch long, and secured to the cylinder by small screws in rear; internally there is a manganese bronze valve key which fits into an undercut groove in the cylinder and is secured by a screw; the front end of the cylinder is prepared for the large or inner gland which is screwed in, and which contains an L-leather; the stuffing box for hydraulic packing screws into this inner gland, the packing being tightened up by a small or outer gland which screws into the stuffing box; the rear end is prepared internally for the reception of the controlling ram, externally it is cupped out so as to offer a large surface to the air in the chamber. It has a filling and emptying valve on the underside and an air plug on the top.

The *piston* with rod is of steel, 6 feet 8.6 inches long, over all, 6.2 inches diameter, bored out internally for the controlling ram and manganese bronze adjusting valve tube. The piston is 10 inches diameter, and has two manganese bronze rings let into undercut annular grooves to prevent wearing the cylinder by scoring; there is also a port for the valve key of the cylinder. The piston rod is screw threaded in front for the connecting collar and nut respectively,

The *controlling ram* is a steel rod 2 feet 10.8 inches long, over all, and 3.4 inches diameter, tapered at the point; it screws into the rear end of the cylinder. A channel is bored along the centre, terminating radially near the base, for the passage of fluid from the hole in the piston rod; the point is furnished with inlet holes, and is threaded to take the adjusting valve; the latter is made of forged steel, 4.45 inches long, over all, grooved longitudinally, and is screwed into the controlling ram from the front end of the piston rod, from where it is also adjusted.

The *air chamber* (F) is a manganese bronze casting; it is 8 feet 4.5 inches long, 18 inches diameter outside and 15 inches inside, divided into two parts by a diaphragm, the rear part containing the tube (h), which has a valve at either end for charging the chamber. The front end of the chamber is closed by a gland containing hydraulic packing, secured by a metal flange. To prevent the escape of air over the gland, liquid is supplied to the gland by an intensifier, at a higher pressure per square inch than that of the air. A small port (i), admits air, also a small quantity of the 3 quarts of oil in the chamber, into the cylinder of the intensifier. There is an air escape valve on top of air chamber over the main gland, to allow air to escape from the gland when filling the intensifier by funnel.

For charging the air chamber an air pump is connected to one of the wing channels (j), while an indicator registering pounds is applied to the other channel, and by opening the valve (k), air will be admitted to the chamber up to an initial pressure of 200 lb. per square inch.

A small air pump is attached to the carriage for maintaining the internal pressure in the air chamber.

The *intensifier* (G) is for supplying liquid to the gland, as before stated, and consists of a cylinder cast in the rear division of air chamber; it has an internal diameter of 4.6 inches, provided with a piston and rod, inner and outer glands, all of manganese bronze; the piston has a suction leather front and rear secured to it by thin plates and screws, and has a stroke of 10 inches. The cylinder will require refilling when the rear of the piston rod is about flush with the rear of the inner gland; filling is effected by applying a pump to the filling hole, marked "A" on the plug (*see care and preservation*, page 70); oil will flow into the cylinder in rear of the piston, the pressure of which will be greater than the air and oil coming through the small port (*i*), from the air chamber; thus the oil will be forced through the pipe (*l*), on to the air chamber main gland. In the absence of a pump, a funnel and special clamp may be used, the latter for pushing in the piston rod; this clamp consists of two tie-rods, which screw into holes in the rear of air chamber, one on either side of intensifier, a cross-piece to be applied on the piston rod and a compressing screw with lever.

Pressures.—The diaphragm of air chamber will stand a pressure of 500 lb. per square inch, and the complete air chamber, with intensifier, a pressure of 1,200 lb. per square inch.

Action.—When the buffer and air chamber are charged (*see care and preservation*, page 69) before firing, the liquid in the buffer is in front of the piston, and on firing, the cylinder of the buffer is forced into the air chamber; when the liquid passes behind the piston, through the port, the resistance offered by the fluid checks the recoil, assisted by the resistance of the compressed air in the chamber on the cup-shaped end of the cylinder. Air displaced by the advancing cylinder is forced into the rear portion of the chamber through small holes at the centre of the diaphragm, at a pressure about equal to three times that of the initial pressure; this increased pressure, over the normal, acting on the piston of the intensifier through the small port, accelerates the force of the liquid through the pipe on to the gland. The air thus stored up, on complete recoil, pushes the hydraulic buffer cylinder forward, and in doing so brings the gun to the firing position. The controlling ram on entering the hole in the piston rod displaces the liquid received when the cylinder was in the rearward position, the liquid returning through the valve and hole in the ram, the resistance of the liquid on the ram prevents the gun running up too rapidly.

Carriage, Shields, and Sighting Platforms.

(*Plates XXIc and XXId*).

The *carriage* (H) consists of two side brackets, built up of steel plates and angles with cradle trunnion bearings, which are strengthened by a casting rivetted on to the outsides; these castings have projections for the supporting screws of the ball bearings of the cradle. The sides are connected by having two front, two rear, and two intermediate transoms of steel plates and angles rivetted to them. Two bolsters or box transoms are fitted to the underside of the carriage, each one, front and rear, has an upper roller path fitted to its under surface to take a bearing on the live roller ring (HH), which is the same as for the Marks III and IV barbette carriages.

Two plates for connecting the carriage to the pivot are fitted to the carriage, one between the box transoms, the other at right angles, rivetted together and to the box transoms; there is a hole in the centre, where these plates cross, fitted with a metal bush for the pivot plug. An iron block or plate is bolted to the breast transom, to which is secured the front clip plate. The front and rear clip plates (I and J respectively) are bolted to the carriage and engage under the outer flange of the pivot plate.

The carriage is provided with steel cap-squares, screwed down, for securing the cradle in its bearings. A wood stop to limit elevation is secured at the rear transom, and two steel stops to limit depression are secured to the stays carrying front shield. The upper part of the mounting is reached by stairs in the work.

Shields.—Four shields are provided: one for the protection of the shell pit, which also answers the purposes of a platform from which the sighting platforms are reached, loading arrangements, &c., are attended to, while to its underside a circular overhead railway is constructed for the projectile trollies: another, the front shield, is for general protection: while two small side shields are principally for the protection of the air chamber.

The circular shield for shell pit (K) is 27 feet 9 inches diameter, and consists of cantilevers or girders made up of plate and angle steel, supported by knee brackets fixed to the carriage, namely, two on each side and ends; $1\frac{1}{4}$ -inch steel plates are rivetted on top of the girders to form the platform. Near the outer rim of the shield is a flange of sufficient depth to admit of the shell trollies running on top of its inside flange, termed the outer rail; an inner rail with a similar flange is fixed to the girders of the shield by knee brackets; the gauge of the rails is 3 feet 9.2 inches. A short length of the inner rail is made removable at the rear by being secured with bolts and nuts, instead of rivets, so that the trollies may be removed when required. A grating is provided on the right side, and openings in rear for the projectile hoist and loading gears for which there are hinged cover plates; those over the rear hoist must be removed before firing to allow the gun to recoil free of the shield, and at the same time a pin in the side of the carriage limiting elevation is removed.

A sighting platform (L) is erected at each side of the carriage on top of shield.

The trollies (M) are for carrying the projectiles on their sides from the front hoist (N) of the pit to the loading position or rear hoist (O). Each consists of a steel frame mounted on four flanged rollers of 5.75 inches diameter across the flanges, with a clip plate at each end; a wood buffer or striker block, furnished with a rope handle, is bolted on to each side of the frame, and a wood housing block, a pair of steel hinged bearing straps, secure the shell in transit. The outer clip plate of the trolley has a groove to engage two spring catches, which secure the trolley in a position suitable to the hoists, that for the front position is on arm (P), secured to the parapet of the work, and the other to a bracket (Q) on the outer rim of the above mentioned shield.

The front shield (R) is a 6-inch steel plate, made in halves, and fitted together when in position by a steel butt plate and screws on the inside. The shield is winged to the rear and splayed outwards at the bottom; it stands on the shell pit shield, and is secured to the carriage by steel elastic stays with disc springs. The front is cut away to suit the gun, and also for the sights.

The dimensions are 10 feet 4 inches across the front, and 8 feet at the sides.

The *side shields* (S) are two 4-inch steel plates, each one is secured to the carriage by steel elastic stays with disc springs; they are on top of the shell pit shield.

Elevating gear.

Plate XXIg.

This gear admits of 15 degrees elevation and 10 degrees depression, and is so arranged that both can be obtained from either side of the carriage, from the sighting platforms, or by an extension of the gear which is worked from the floor of the pit at the left side, the former being slow motion gear and the latter quick.

The gear generally consists of a powerful cross-shaft working in bushes in the carriage sides, and further supported centrally by a steel bracket screwed to the front box transom. This shaft carries two arc pinions which gear with the arcs of the cradle, and a steel worm wheel on its outer end at the right side of carriage. The worm wheel is provided with a friction clutch formed of alternate steel and gunmetal rings, eight of each kind, and two jamming plates, the inner being of gunmetal and the outer of steel, all of which fit on the hexagon flats of the shaft. The adjustment of these is effected (to prevent the gun running down when at extreme recoil) by means of a No. 56 spring disc and two steel nuts on the shaft outside of worm wheel. The worm wheel just described is in gear with a worm on the third-motion or worm-shaft working in metal bearings, and to reduce friction as much as possible in these bearings, an anti-friction ring is fitted on each end of the worm, each one consisting of one outer and two inner steel rings, and 23 steel rollers. The worm shaft is in bevel gear with the vertical second-motion shaft, working in bearings secured to a plate bracket on the front of the carriage, and having on the upper end a bevel pinion in gear with another bevel pinion on the first-motion shaft, working in bearings in casting (a). This last mentioned shaft is actuated by the handwheel (b).

The first and second-motion sections of the gear on the left side are similar to those just described for the right side, both these side gears are connected by a cross-shaft having a bevel wheel on each end, gearing with similar pinions on the vertical second-motion shaft. This cross-shaft is supported in metal brackets on the outside of the carriage and on the inside of the breast transom.

The section of the gear to be worked from the pit is a continuation of the vertical second-motion shaft, left side, and a bevel wheel on its lower end, which is in gear with a similar pinion on a first-motion spindle which is actuated by the handwheel (c). This section of the gear is principally supported in a cast steel bracket secured to the underside of the front box transom. This bracket is also prepared for the lower section of traversing gear.

Elevation Indicator Gear.

This gear is so constructed that the range required will be indicated on the dial by a pointer. It consists of an arc, which is attached to the front of the left elevating arc, in gear with a spur pinion on a short cross shaft working through the left cheek of the carriage, supported by a bracket on the inside of the cheek and a dial or disc bracket on the front box transom. Fitted on the outer

end of the cross-shaft is a dial having a yard scale engraved upon it, the range being indicated by a pointer secured on the underside of the rim of the dial bracket by two screws.

All the parts are made of metal, except the cross-shaft, which is of steel.

Traversing Gear.

(Plate XXII.)

The traversing gear is arranged to be worked practically from the same positions as the elevating gear, and is generally secured to the carriage in a similar way; and like it the lower is quick-motion and the upper slow.

The driving, or rack pinion, is at the right front of the mounting. Its shaft works in a metal bush secured in the box transom of the carriage, and carries a spur wheel which is in gear with a spur pinion on the lower end of a short spindle having a spur wheel at its upper end in gear with a spur pinion on a vertical second-motion shaft, at the upper end of which is a bevel wheel in gear with a similar pinion on the first-motion spindle, which is actuated by the handwheel (*a*) with folding handle.

The upper part of the left side gear is similar to that on the right side before described, and is connected to it by a cross-shaft in a similar manner to the upper part of the elevating gear.

The section of the gear to be worked from the pit is similarly arranged to that portion of the elevating gear, being a prolonged second-motion shaft in bevel gear, a first-motion spindle, and hand-wheel (*b*).

Stops are provided so that practice may be kept within safe lateral limits. These consist of two buffer stops, each including a steel bracket carrying a spindle with two pairs of disc springs, nut and keep pin, the brackets being secured to the pivot plate by screws, and a steel stop, which is secured to the front clip plate of the carriage by screw bolts.

Sighting Gear.

Rocking bar sights, Plate XXII.—This gear is on the left side of the mounting, supported by a metal bracket (*a*), secured to the front transom of the cradle. It consists principally of carrier (*b*), rocking-bar (*c*), sight bar (*d*), with front and rear sights (*e, f*), and telescope (*g*).

The steel carrier is attached to the arm of the supporting bracket by the screw studs *h*. A worm wheel and pinion gear similar to that for the rocking-bar sights of Mark IV carriage, page 40, actuates a drum on whose periphery there is a crown-metal strip graduated to 14,000 yards range with M.V. of 2643 f.s. for full charge; there is also a drum with range strip for $\frac{3}{4}$ charge, the strip being engraved to 12,000 yards with M.V. of 2196 f.s.; and to facilitate reading these range strips, a steel pointer is fitted at the rear of the carrier.

The rocking-bar is connected to the carrier, in front by the pivot pin *i*, and in rear by the arc *j*; the front end is prepared for the pin of sight bar; the rear end for the traversing pin or nut, and a cross-head with deflection leaf graduated to 2 degrees left and right, which is worked by a screw with milled heads, 3 degrees being allowed as correction for drift; the arc on the underside of the bar

has teeth on the front face to gear with the pinion on the carrier, and in rear a scale graduated to 15 degrees; a stop on the lower end of the bar prevents it running out of gear.

The sight bar is a steel tube that carries the sights. The fore sights consist of an acorn on a lug of the bar, and a sighting blade on a hexagon at the front of the turning rod within the bar or tube; the rod is secured by a nut and screw, and can be turned down when not required by the thumb piece *k*; a spiral spring on the turning rod at the rear, within the tube, retains the sighting blade in position. The rear sight is on a lug secured to the sight bar; it has a .06-inch notch.

A telescope is provided for use at distant objects, and is carried in two lugs on the sight bar; it is secured by two linged caps.

For convenience of the gun layer, an adjustable shoulder piece is provided. The stock is of walnut wood, with an elastic pad formed of a length of indiarubber tube, which has its upper end protected by a brass cap secured to the stock by screws.

Automatic Sight, Plate XXI j.—The automatic sight gear is on the right side of the mounting. It is automatically set to the range corresponding to that of the target, by use of a cam action. All that is necessary for use is to align the sight with the target. A correcting gear is connected to the traversing rack to adjust the auto-sight cam with the cradle trunnion axis for any inclination there may be in the pivot.

The gear generally consists of a telescope (*a*), supported in a gunmetal carrier (*b*), a gunmetal hinge flap (*c*) for carrier, gunmetal bracket supporting hinge flap (*d*), gunmetal lever cam roller (*e*), metal bushed at each end, manganese bronze cam roller (*f*), cam (*g*), cam sliding block (*h*), cam tidal correction lever (*i*), and graduated arc (*j*), and spring in gunmetal case (*k*). The above are supported by a steel bracket (*l*) attached to the front transom of the cradle at the right side; this bracket is metal bushed to take the pivot of the cam roller lever, the pivot being allowed 3 degrees inclination correction for drift, and is adjusted by a set screw on top of the bracket.

The telescope is secured in the carrier bearings by steel caps which hinge on the left side and kept down by screw clamps on the opposite side. On top of the carrier is a clinometer plane. Deflection is obtained by the carrier and hinge flap being pivoted near their front ends, there being a traversing rack formed on the rear of the carrier to gear with a worm spindle on the hinge flap; this worm spindle has a drum on its right hand end, the drum has a crown metal deflection scale on its periphery graduated for 2 degrees right and left deflection; a reader to indicate direction, &c., is also provided. The hinge flap is connected to the supporting bracket (*d*) and is given a vertical movement by a joint pin in front and an "error of day" nut arrangement in rear, the nut being clamped by a jamming lever; there is a reader on the rear of the bracket *d* to facilitate reading the nut graduations. The bracket *d* slides into and is secured on top of the cam roller lever, the latter being pivoted to the steel bracket (*l*) on cradle; the lower end of this lever carries the cam roller, which is kept up to its work by the steel spring (*k*); one end of the spring spindle is attached to the eccentric spindle of the cam roller, the other end being attached to the carriage. The cam is fixed to the sliding block in the guide (*m*) secured to the carriage by screws, the block with cam being actuated as to level of racer by the eccentric rod of the correcting gear. There is a separate cam for the full and $\frac{3}{4}$ charges, but these cams are substituted by one

cut to the range limit of the 1-inch aiming rifle, when required, so as to give increased practice in laying with these sights. Adjustment of the cam for tide level is effected by the lever (*i*) which is connected to the cam, and works on the metal graduated arc (*j*), showing rise and fall of tide, the lever being clamped on the arc by a fly nut.

For convenience in laying the gun a shoulder piece is provided as for the "rocking-bar sights" before mentioned.

For care and preservation, see "Magazine Regulations."

Loading Arrangements.

These generally consist of a steel arm with loading tray, derrick with hand tackle, and a front and a rear hydraulic hoist with accumulator gear.

The *steel arm* is made of plates and angles rivetted together; it is bolted to a projection at the left rear of the cradle, the outer end is prepared for a joint pin upon which the tray pivots.

The *tray* is of metal connected to the before-mentioned steel arm by the joint pin, a spring locking bolt being used for securing it in the required position; a steady pin is provided to engage a corresponding hole in the left face of the bronze end frame of gun. The tray is intended to protect the screw threads in the breech of gun while the projectile is being rammed home; after the cartridge is loaded the projectile tray is swung back and the breech closed.

The *derrick* is made of two steel curved plates connected by collar bolts, and secured to a pivot piece by screws; the pivot piece is flanged and tapered and provided with two bearing surfaces which fit into corresponding metal bushes in the lugs of a steel bracket at the left rear of the carriage. The top of the derrick is fitted to take a Weston 5 cwt. differential tackle, consisting of pulley blocks and a suitable length of chain.

When using the derrick the projectile is brought to the rear of the carriage in a barrow, and then raised from the pit to the loading tray, which is then swung round to the breech of the gun.

The Hydraulic Gear.—By means of the compressors on the cradle, a quantity of the energy of recoil is utilized in supplying hydraulic pressure for the loading gear. A spring accumulator is installed in the works, fitted with a controlling valve for transmitting pressure through a system of pipes to the front or rear hoist as required.

The gun may be loaded at 5 degrees elevation or depression, in any position of traverse.

Six trolleys, see page 46, are provided, which convey projectiles from the front to the rear hoist.

The front hoist may be worked at any time, so that two or three projectiles may be ready to run over the rear hoist.

With this gear the projectile is brought in a barrow and laid in the tray of the front hoist (N, Plates XXIXc and XXXId) in the floor of the pit, then raised to and secured in an overhead trolley (M), which is run round to the rear hoist (O), to which the projectile is transferred and raised to the loading tray, the latter being swung into the breech chamber before the former is raised.

Weight of accumulator about 3 tons 10 cwt. 0 qr. 0 lb.

" front hoist	0	"	10	"	2	"	0	"
" controlling valve	0	"	1	"	0	"	5	"

*Electric Firing Gear.**(Plate XXI^k and l.)*

Electric firing may be effected from three stations by means of pistol grips, secured to the mounting convenient to the layer, from either the left or the right side, or from the ground level. From either of these positions a circuit is made to the gun and battery by leads through a "safety plug box" and a rubbing contact. In preparing for firing it should be seen that each lead corresponds with its lettered position.

The gear generally consists of an electric battery of four Le Clanché cells, A, Mark III, in a box,* which is secured to the front box transom of carriage at the left side, three pistol grips on suitable brackets, a safety firing plug box on the right front cantilever of carriage, two rubbing contacts, M,¹ braided electric cable with coupling screws as allowed by "Equipment Regulations."

The lengths of cable are arranged as follows:—Three leads from the electric battery, one to each pistol contact, three other leads from contact of pistols to safety firing plug box. The leads from the right side pistol contact are carried down under the gun and secured across the breast of the carriage. A single cable is led from safety plug box across breast of carriage and along the right side of cradle and connected to a rubbing contact, another length of cable is connected to contact on sliding bar of gun and led along to and round the carrier to the lock in the gun. The cables are secured in metal clips, which are fixed to the gun and mounting by screws. There is an additional terminal on the safety firing plug box for the attachment of a tester, or wire from position-finder, the second wire from position-finder being connected to the battery, *see* leads X Y, fig. 5, page 76.

The following traversing arc, holdfast, pedestals, pivot plates and pivot plug, are used with this carriage.

(Plate XXI^c.)

ARC, TRAVERSING, NO. 34, MARK I.

The arc is fixed on below the flange of the pivot plate, at T, for description, *see* Mark III carriage, page 36. A pointer for indicating the angle of traverse is fixed to the carriage.

HOLDFAST, CARRIAGE PEDESTAL, NO. 4A.

This holdfast (U) is identical with that for Mark III carriage, page 37.

PEDESTAL CARRIAGE, NO. 4.

Mark I: this pedestal is the same as for the Marks III and IV carriages; with this carriage it is used with six mounted at Dover.

PEDESTAL, CARRIAGE, NO. 7.

Mark I pedestal (V) is a hollow iron casting, cast in halves and bolted together by means of junction plates and bolts when the pedestal is placed in position. The top and inside surfaces are

* The pattern of battery box is not yet decided, meanwhile a suitable box will be made locally.

prepared to take the pivot plate. There are twelve holes cast vertically through the top and sides with pockets, V^1 , at equal distances, for the levelling screws, which are provided so that the pivot plate with racer may be kept perfectly level from time to time. Each vertical hole is fitted with a metal flanged socket, secured by a set screw from within the pedestal, and threaded inside for the levelling screw; each screw is 20.8 inches long, over all, and 4.6 inches diameter, the lower end has a capstan head, and the opposite end a hard bronze bearing plate .2 inch thick, fitted on; the top end of the screw fits into a flanged steel nut, having a bearing on the metal socket before mentioned; the nut is 6 inches diameter and 8 inches across the flange, curved on the top to suit the bearing in the pivot plate, and provided with lubricating holes which are connected with those in pivot plate.

The levelling screws are manipulated by applying a tommy or pointed lever in the capstan heads, and then clamped by a screw bolt, having a metal bearing piece screwed on to its point, which passes through a hole in the pedestal and socket from the outside.

The pedestal is secured to the work by the holdfast.

Weight 17 tons 8 cwt. 1 qr.

Mark II pedestal differs from Mark I in not being provided with levelling screws, an automatic correcting gear being used instead.

Weight 16 tons 16 cwt.

PLATE, PIVOT, No. 4, CARRIAGE PEDESTAL.

Mark I pivot plate (W) is of steel; with racer and traversing rack with fixing screws. It is used on No. 4 pedestal with the six carriages mounted at Dover.

Weight 8 tons 12 cwt. (including bolts).

PLATE, PIVOT, No. 7, CARRIAGE PEDESTAL.

The object of this pivot plate is to enable the mounting to be levelled when necessary, owing to uneven settlement of the pedestal, by means of the levelling screws in the pedestal, the bolts by which the plate is secured to the pedestal being loosened for the purpose, and again tightened up when the mounting is truly level.

Mark I is of steel (W) cast to shape and fitted on top of the pedestal by bolts on either side of racer, there are 30 bolts on the outside and 16 inside of the racer. In the centre of the plate there is a hole having a shoulder to suit the pivot plug. There is a flange on the underside to take a bearing against the inside face of pedestal, while another flange cast on the outside rim gives a bearing to clip plates.

Manholes are cast between the strengthening webs of the plate. In the hollow of the upper side is fitted and bolted the steel racer or lower roller path. On the underside, below the racer, are twelve shallow circular holes, having metal bearing blocks fitted in for the nuts of the levelling screws of the pedestal; each bearing block is provided with lubricating holes and grooves, which terminate in one end and lead up to the top of the outer rim of pivot plate by a copper pipe.

A segmental traversing rack (X) is secured above the clip plate flange of the plate by screw bolts.

Weight 8 tons 12 cwt. (including bolts).

Mark II pivot plate is not fitted for levelling screws, otherwise it is the same as Mark I.

Weight 8 tons 16 cwt. 1 qr. (including bolts).

PLUG, PIVOT, No. 19.

Mark I: this is of steel, with securing plate and screws. The plug (Y) has a flange to take a bearing on the shoulder of the hole in pivot plate and in bush of carriage. It is prevented from turning by a steel feather let into a feather way. The plug is prepared for the pipe (Z) of the hydraulic gear, and is for use with Nos. 4 and 7 pedestal pivot plates.

Weight 6 cwt.

SLIDE, L., BABETTE, B.L., 9·2-INCH, MARK I.

For carriage, *barbette*, Mark I, page 28.

(Plate XII.)

The slide is of steel, and consists of two girders, having a slope of 5°; they are connected by front and rear box transoms, a front transom and a centre beam form the pivot plate; it revolves about a centre pivot. The pivot plate carries a brass bush, which the pivot passes through. The slide is fitted with two front and two rear trucks; traversing gear; retaining gear for holding the carriage in loading position; loading and sighting platform, fitted with a sighting step on both sides; a loading derrick; and two volute spring buffers on spindles, secured to the front transom by nut and key.

Clips are fitted on the front truck brackets, which engage a flange on the pivot plate, to prevent the mounting from tipping.

A graduated arc E is let into the floor of the work, and a pointer F is fixed to the rear of the slide, by which the angle of traverse is indicated.

The "Battery and key, test and firing," see page 72, is supplied to be placed at G.

The battery remains at G, the firing key only being shifted to the bracket at G¹ when required. See page 74, for electric firing arrangements.

Traversing Gear.

(Plate XII.)

The traversing gear is fitted on both sides of the slide, and connected to the front trucks. Handles are shipped on to the first motion spindles of the gear, and the rotation of these is communicated to the front trucks, and thus the gun is traversed.

Retaining Gear (for holding the Carriage back in loading position).

(Plate XII.)

An automatic retaining catch is fitted on the right side of the slide for holding the carriage in loading position; it catches against the front edge of the holding-down clip. On lifting the lever, the carriage is released, and will run out. In latest manufacture this gear has been discontinued, the gun being loaded in the "run up" position; but where fitted it will be retained so long as "remains serviceable."

C. Pivot and Truck-path.

The pivot-block and clip ring are in two heavy castings, which are securely bolted together, and firmly bedded and bolted in concrete. A steel truck-path is secured to the upper surface of the pivot block.

Weight { pivot piece and pin 9 tons 9 cwt. 2 qrs.
 { holding-down bolts and anchor plates, 19 cwt. 3 qrs.

SLIDE, L., BARBETTE, B.L, 9·2-INCH, MARK IA.

For carriage, *barbette*, Mark IA, page 30.

This slide differs from Mark I in being slightly wider between the brackets to take the Mark I guns.

SLIDE, L., BARBETTE, B.L, 9·2-INCH, MARK IB.

For carriage, *barbette*, Mark IB, page 30.

The slide differs from Mark IA in having a differently constructed sighting platform, which is higher and fitted with two steps, one to lay the gun at 5° depression, and the other (a folding step) 10° depression; the loading platform is increased in height, and the iron of the upper portion is covered with wood to afford a good foothold for the numbers serving the gun; and a stop is fitted to the derrick to prevent it swinging towards the front when the gun is fired.

SLIDE, L., BARBETTE, B.L, 9·2 INCH, MARK II.

For carriage, *barbette*, Mark II, page 30.

(*Plates XIV and XV.*)

The slide consists of two girders, having a slope of 4°, connected by five cast-steel transoms. Each girder is built up by rivetting iron plates on both sides of a top bar of T steel, and a bottom one of T iron.

The front end is supported on a casting of steel (*c'*), which forms a transom with brackets (*d*) for the front trucks. The rear end rests on a supporting frame (*e*), which is hinged to the rear transom at (*f*), and to a steel casting at (*g*). The casting (*g*) is formed with brackets for the rear trucks, and is kept on the racer by two channel iron bars (*h*) fixed to a band (*i*) which works in a groove round the pivot block. The stop bracket (*k*) is fixed to the front casting (*c'*) and projects downwards in front of the racer, to prevent the trucks leaving the track. Two horizontal rollers are fitted to the rear of the casting (*c'*) and four rollers to the front to bear against the racer and reduce the friction when traversing. Two heavy cast

iron blocks are fixed to the rear end of the slide to bring the centre of gravity of the gun and mounting approximately over the top of the pivot. Removable covers are bolted to the castings (*d*) and (*g*) to facilitate the removal of the trucks for cleaning purposes.

The slide is fitted with front and rear buffer stops (*y*) composed of steel disc springs; suitable wood platforms at the rear, with ladders (*o*) and hand-rail attached, for loading and firing the gun; and a compound armour shield if required.

The electric firing gear is fitted on the right side, the battery on the side at X^1 , and the firing key on hand-rail at X^2 . See also page 72.

On the right side a longitudinal shaft is secured in bearings, a hand wheel being fitted at the front end of the shaft for giving motion to the elevating gear on the carriage.

Traversing is effected by a cross shaft with bevel pinion, transmitting motion from the winch handles (*r*) to a longitudinal shaft fitted with two sprocket pinions on its end. These pinions convey power by two chains to two sprocket wheels keyed on two parallel shafts, which are also fitted with bevel pinions. These pinions actuate bevel wheels on two oblique shafts fitted with spur pinions, which gear into teeth on the trucks (*s*).

Loading Derrick.

A derrick (*t*) is attached to the slide for loading at any angle of elevation up to 17 degrees. The projectile is raised by a steel wire rope, which passes over sheaves fitted to the derrick; this rope is wound on a drum at the foot of the derrick, a shaft passes through the drum to take a winch handle; on the same shaft is carried a brake drum connected to the rope drum by a ratchet wheel and pawl. The projectile can be lowered to a convenient position for loading, from the loading platform, by means of a rod (*u*) attached to a lever (*v*) connected to the strap of the brake drum.

A pointer is fixed by a metal bracket to the front transom, right side, to indicate the angle of traverse on a graduated arc let into the concrete.

Hydraulic Pivot.

An hydraulic pivot is fitted to take the greater part of the weight off the trucks in order to decrease the work in traversing. It consists of a cylinder and ram fixed on the top of the pivot block. The ram presses upwards against a block fitted into the centre transom; the liquid is passed into the cylinder through the top of the ram by a pipe leading from a pump fitted to the centre transom. This pump has two rams, one arranged to be worked from the hand lever, and the other from the winch handle shaft of the traversing gear; the slide is raised by means of the hand lever, and kept up during traversing by the action of the eccentric fitted to the winch handle-shaft; however, the eccentric is not now required, as the following packing for the ram has been introduced. The lift is regulated by links connecting a releasing spindle to the pivot band; this spindle lifts the suction valve when the slide is at the required height, which is shown by a pointer which forms part of the regulating gear. The lifting ram is not provided with packing leathers, but it has a groove cut 0.4 inch deep and 1 inch wide, packed with a mixture of tallow and coarse asbestos fibre, inserted through eight $\frac{1}{2}$ -inch holes drilled in the bottom of the ram;

any liquid which overflows while the pump is being used runs into a circular tray, from which it passes into a tank to which the suction pipe of the pump is coupled. For liquid used see page 66; also "Equipment Regulations."

Pivot Block and Racer.

The pivot block is in one casting of iron, formed with a groove for the band (i). The top is fitted to take the cylinder for the hydraulic pivot gear, the upper part of this cylinder is made rectangular, and slides in a hole of similar shape in the block fitted to the inside of the centre transom.

The racer is of steel, cast in eight segments, with a hook on its outer circumference which takes the shock of recoil transmitted through the clip brackets.

				ft.	in.
Height of slide	..	..	..	6	8.46
Length of slide	..	..	..	22	11.25
Height of pivot block	..	..	..	4	10.584

NOTE.—9.2 Mark I guns will not be mounted on Mark II mounting.

CARRIAGE, GARRISON, DISAPPEARING, B.L., 9.2-INCH,
MARK I.

(Plates XXII to XXVIII.)

The principal parts of the carriage are:—

1. The circular lower carriage or turntable, which is placed in the second pit, with its top surface level with the floor of the gun pit. (B, Plates XXII and XXIII.) For facility of transport this divides into four pieces, namely:—the front piece, which weighs about 4 tons; the rear piece, which weighs about 2 tons; the two side pieces, which weigh each about 1 ton.
2. The main girders span from side to side of the circular lower carriage, carrying the recoil cylinder between them. (B', Plate XXII.) These weigh each about 1 ton.
3. The rocking carriage or elevator, with the crosshead, which is made up into one piece, weighing about 3 tons. (A, Plates XXII and XXIII, and K, Plate XXIV.)
4. The recoil cylinder and ram together make the heaviest piece, and weigh 5 tons. (H and J, Plate XXIV.)
5. The live rollers, which are held in place by the live roller ring, and run between the upper and lower roller paths. (W, Plate XXII.)
6. The rack, fixed to the lower roller path, with the traversing gear working into it, and carried on the circular carriage.
7. The elevating gear. (Fig. 2, Plate XXIV.)
8. The carriage is also provided with a large over-head shield, somewhat less in diameter than the mouth of the gun pit, and of a thickness of 1 inch. (C, Plates XXII and XXIII.) This shield is stiffened on the under side by plate and angle beams, and is supported from the circular carriage by eight pillars constructed of angle bars. (C', Plate XXII.) For facility of transport and erection the shield is made up into four pieces, each weighing about $5\frac{1}{4}$ tons.

Besides the above there are many minor fittings, such as:—

- (a) Sights on the shield for approximately laying the gun before it is raised above ground. (F¹, Plate XXII.)
- (b) A pump on the recoil cylinder, for getting the gun down without firing it. (S, Plate XXIV.)
- (c) A set of hand-rails under the shield, around the chase of the gun, to prevent a man from standing where the gun might strike him, if fired. (Not shown in Plate.)
- (d) A set of cut-off gear, acting upon the lever which controls the motion of the gun raising valve, to bring the gun gently to a stop at the firing position. (T¹, Plate XXIV.)
- (e) Securing gear, to lock the gun down. (XX, Plate XXIV.)
- (f) Ladders, to reach the top of the shield.
- (g) Hinged platforms, for obtaining a standing position behind the gun sights, these being made to spring clear of the gun after use. (G, Plate XXII.)
- (h) Indicator and direction plates, as guides in working the carriage.

Weights, elevation, &c., see table, p. 27.

A description, more particularly of each of the main parts, of the carriage according to the order of the above list:—

Lower Carriage.

(Plates XXII and XXIII.)

The lower carriage with its main girders is constructed of mild steel plates and angles. It has no actual centre pivot, but is held in place, so as to revolve about its centre, by double flanged live rollers, which work between the upper and lower roller path (Y); and by the front and rear clips, which prevent more than a trifling lift from taking place when the gun is fired. The front clips (E) are five, and rear clips three, in number, made of cast steel, of a form to hook under a rim formed for the purpose on the lower roller path; they are each secured to the carriage by 12 large bolts. The carriage is fitted with sockets and footsteps for the shield pillars, and at its front end with the brackets for the pivot of the rocking carriage. To keep the recoil within safe limits, a series of disc springs are fitted on the buffer stops, which also have a dead stop to take the weight on the springs being compressed.

Between the circular girder at each side and the main girders there is room for the numbers employed in traversing and elevating the gun, and a chequered foot-plate is provided for them to stand on, about 2½ feet below the level of the floor of the gun pit.

A metal bracket (X¹) is fixed on the right side near the rear of the carriage for the "Battery and key, test and firing" (page 72), and two (X²) and (X³) for the firing key, one secured to the hand-rail of sighting platform, and the other convenient to the shield sights on top of the shield (see also page 61). For arrangement of leads, &c., see page 76.

Elevator Carriage.

(Plate XXIV.)

The elevator carriage consists of two cast steel beams of curved form, united together, wherever there is space clear of the gun, by cross transoms. At the top they are formed into bearings for the gun trunnions, and are fitted with capsquares. These capsquares slide into place from the outside, and are secured there by dog-tailed pins, made with a spring and key, to prevent their being shaken out. The arms of the recoil-ram-crosshead pass through bearings near

the centre of the elevator carriage; these bearings are prevented from turning in their seatings by three small screws, which are inserted between each bearing and seating. This crosshead, therefore, cannot be taken out when the beams and cross transoms of the elevator carriage are once rivetted up. At the bottom the beams of the elevator carriage have bushed holes for the pins on which it pivots when the gun goes up or down.

With a view to avoiding the possibility of the gun being fired before it is fully "up" in the firing position, the rear web of "elevator" is fitted with an arrow plate and "bracket, pin, joint, elevator" with a pointer, in such a position as will clearly indicate, when the pointer and arrow coincide, that the gun is in the correct firing position.

Recoil Cylinder.

(Plate XXIV.)

The recoil cylinder is bored out from a solid ingot of mild forged steel. This method of construction is adopted to get rid of the uncertainty attendant upon the manufacture and employment of a casting, but it has also the great advantage that the compressed air used for counter-balancing the weight of the gun is contained in about a dozen chambers in the place of one, so that if the cylinder were torn open by being struck in action the compressed air would escape only slowly and without explosive effect. The cylinder is screwed into a cast steel trunnion ring, the trunnions of which are supported in brackets fixed to the main girders of the lower carriage. The centre of the cylinder is bored out for taking the recoil ram, and is fitted at the top with a packing gland (R). To prevent the ram from coming out of the cylinder at the end of its stroke, it is provided with a divided piston, and there is also a divided internal collar at the top end of the cylinder; the lands and grooves thus formed allow the ram to pass in or out, but when partially turned round the ram is locked and prevented from coming out again. From the inner cylinder to the air chamber passages are cut, and these are fitted with four recoil valves, which permit liquid to pass from the inner cylinder to the air chambers, but not to pass back again. These recoil valves can be reached by removing the end plugs (M). The lowest plug of the air chamber is fitted with a draw-off valve and tube.

For the liquid to pass back again when the gun has to be raised, a raising valve is provided at (L), and this is opened by a rack and pinion moved by the rod (T) and hand lever (D). It is shut automatically as the gun rises by a slotted link rod attached to the elevator carriage, which also acts upon the rack and pinion through the rod (T). Near the middle of the cylinder, on the top side, is a filling cock (N) and a liquid level valve (P). An air relief valve, giving a vent to the inner cylinder, is fitted at the top of the cylinder at (Q).

The recoil ram is made of manganese bronze; the bottom has a radius of 0.15, to prevent it setting fast in the bottom of the cylinder if lowered without liquid behind it. It is fitted at the top with a spring draw buffer (*see* fig. 1). This is made up of 15 dished spring washers (KK), and the draw bolt (JJ, fig. 1) which connects the crosshead to the ram. This arrangement allows the cross-head to be drawn off the ram about 2 inches, against the action of the springs, if it should happen that the gun rises too violently into firing position.

*Action of Recoil Valves, &c.**(Plates XXV to XXVIII.)*

The recoil valves are four in number; they are fitted in the bottom of the recoil cylinders, and their action is to regulate the passage of liquid from the interior of the cylinder "A" to the air-chambers "BB," and to prevent its return.

When the gun recoils, the liquid in the central chamber of "A" is forced through the valve "i," lifting it against the adjusting nut "l," and compressing the spring "k"; the liquid then passes through the passages "mm" into the air-chambers "BB."

The valve resistance, and consequently the length of the recoil, is regulated by means of the adjusting nut "l," which, by forming a stop for the valve, limits the lift or the distance it moves from its seating.

A set screw "p" is provided for locking the adjusting nut "l," and eight slots are cut in the point of the spindle "n" to receive the end of the set screw "p."

The difference made in the lift of the valves by moving the adjusting nut of each valve through $\frac{1}{4}$ of a revolution is sufficient to decrease the stroke of the ram 3 inches, limiting the recoil a corresponding amount. This information is stamped on the face of the nut "l."

The valve is pressed on its seating by the spring "k" and by the pressure of the air in the air-chambers.

Raising the weight (see para. 2 above), a small groove is cut on the screwed portion of the air-plug, so as to allow the escape of air which accumulates in the inner chamber.

In the case of guns equipped with cordite cartridges and which fire powder charges at practice, *precaution must be taken to prevent guns from being fired with powder charges when the recoil valves are set for cordite. On completion of firing with powder charges, the recoil valves will be at once reset for cordite.*

Live Roller Ring.

The live rollers are carefully coned to suit the circle round which they travel, and being all of the same size they have therefore no tendency to get out of place; nevertheless it is considered safer to hold them in place by a live roller ring, which consists of two concentric steel rings connected by collar rivets, and furnished with metal bushed holes for the axles of the rollers; it carries 18 "Rollers, carriage, No. 9," which are flanged and metal bushed, to prevent their rusting fast to the axles.

The advantages of mounting the carriage on live rollers in place of an actual pivot are, first, that the shifting of the gun from one position to the other does not alter the amount of work to be done in traversing the gun; and, second, that with properly made roller paths and rollers the work of traversing is extremely small, a force of only about 8 or 10 lbs. being required for each ton of weight moved. Thus, in the present case, the revolving weight of gun carriage and shield is, say, 66 tons, so that the application of a horizontal force of, say, 600 lbs., at the radius of the roller path will produce motion.

Rack and Traversing Gear.

The rack fixed to the lower path is of steel in short lengths. The teeth are placed vertically, so as not to get choked with dirt. There are 285 teeth in the complete circle.

The rest of the gear used for traversing the gun is carried on, and therefore revolves with, the carriage. On each side is a pinion with 13 teeth gearing into the training rack, and driven through the third motion shaft by a spur wheel which has 40 teeth. Into this spur wheel a pinion of 12 teeth on the second motion shaft is geared. The second motion shaft is driven by a pair of mitre wheels of 25 teeth, contained in the box guard, on the top of the circular carriage. The first motion shaft, on which one of these mitre wheels is fixed, has a 3-foot hand-wheel (WW, Plate XXIII), with a crank handle keyed to it. For traversing a short distance it will be found most convenient to haul on the top of the rim of the hand wheel, but for a long distance the crank handle is more easily worked. The speed of travel of the rim of the handle wheel is 20 times that of the carriage at the radius of the roller path, so that the power to be applied at the rim of the hand wheel is $\frac{1}{20}$ th of the 600 referred to above, that is to say, about 30 lbs. There is an indicator plate marked "right" and "left," meaning "trail" to the right or left.

Elevating Gear.

(Plate XXIV.)

The elevating gear gives elevation or depression to the gun by means of two long rods which are pivoted at their upper ends to an elevating band tightened on the breech end of the gun, and are hinged at their lower ends to the toothed elevating arcs (BB), actuated by a train of toothed gear and hand wheels fitted to the carriage. This gear has an elevating shaft (YY), provided with an automatic regulating brake (EE), for the following reasons:—

When the gun is in the firing position, and it is necessary to depress it, the elevating rods (weighing about 660 lbs.) have to be lifted by the elevating gear; but if the gun has to be elevated the weight of these arms is sufficient to make the gear run away when once put into motion. This is compensated for by the brake, which is made with a friction pawl which grips the drum (NN), when the gear revolves in the direction required for elevating the gun, so as to turn the drum on its cone, and set up enough friction to more than counteract the weight of the rods (AA, Plates XXII and XXIII). When, however, the gear is turned in the opposite direction, the pawl slides freely over the drum, so as to avoid turning the brake. The springs (JJ, fig. 2) should be adjusted to hold the drum and cone together till the friction produced is sufficient. This may be very fairly judged by making the power required on the hand wheel for elevating the gun the same as that for depressing it.

The main elevating shaft (CC), is not rigidly keyed to the cog wheel (LL), but is driven by friction plates of alternate steel and bronze. These plates should be tightened into the wheel by the spring (GG), and the nut (HH), sufficiently to ensure that the cog wheel will not slip round without moving the shaft (CC), under ordinary circumstances, but that it shall so slip whenever the shaft is jerked violently round when the gun is fired. This frictional driving apparatus is introduced to prevent the teeth of the wheels from being overstrained. It is of importance that the spring (GG) should be properly tightened. This can be tested by fixing the shaft (CC) so that it cannot revolve, and by then hanging a weight of about 95 lb. on each handwheel at a radius of about $12\frac{1}{2}$ inches from the centre. This weight should just cause the gear to slip.

The range of elevation and depression is given by yard scale, which consists of a strip of metal fitted on the outside of the elevating arc guide, and curved to suit its shape. The graduations for yards of range are engraved on the face of the plate, the range being indicated by means of a steel pointer attached to the elevating arc. The elevating arcs have a long range of travel, because when the gun is fired it is necessary to let them follow the movement of the gun. The arc guides are fitted with spring buffers to check the movement of the arcs if they run up too violently. It may be considered advisable to graduate the guide on the opposite side of the carriage with a range table in yards, but this should be done on the spot, and the height above the sea level should be taken into account in working out the range table.

Shield.

The overhead shield is intended to keep out fragments of shell bursting overhead. It is made in segments, which are bolted together, and supported on the lower carriage by pillars. When the carriage is mounted in closed circular pits, sliding cover plates are provided for closing the emplacement against intruders. In hot climates the shield may be covered with a non-conductive material to keep the gun pit cool. It may be used for a look-out platform. A sighting platform, furnished with hand-rail, having a bracket for firing key attached to it, is fitted on rear top of shield, to enable the layer to lay the gun by means of the service sights. There are two ports or manholes through the shield, each provided with a ladder from below. The forward port has in front of it a pillar, which serves both as a help in getting up, and as a socket for a rough back sight, by which, with the aid of a similar fore sight, the gun may be brought approximately into correct line before being put into view. To enable guns to be laid more accurately for direction, before the gun is "run up" into the firing position, the shield is now fitted with a bracket for the reception of one of the gun tangent sights and the spindle of the rough fore-sight with a socket at its upper end to hold one of the gun fore-sights. The sights used are spare "right" fore and tangent sights of the gun. A steel blade being attached to the existing sighting blade of the tangent sight by three screws, the sighting edge being adjusted to the angle of deflection due to rifling. In order that the gun may be fired by the layer using the shield sights, a bracket for the firing key is secured on top of shield, to the right front of fore manhole. The rearward port is near the hinged platforms, from which the gun can be layed by the service sights on the gun. These ports are also fitted with cover plate, which are put in place from below and are fastened on the underside. A roller is fitted on the rear of the shield to give a direct lead to the firing lanyard, excepting when the gun is fired from the top of shield.

Loading Tackle.—This gear is fitted to the rear of the shield; it consists of a radial bar working on an arc of angle steel; along the radial bar moves a bracket which carries a block and fall for lifting the projectile.

Of the minor fittings of the carriage, the following need some little description:—

Pump.

The gun-metal pump (S, Plate XXIV) on the back of the recoil cylinder is a double acting force pump, that is to say, it makes a

suction and delivery with both the up and down stroke. It has two suction and two delivery valves fitted with small phosphor bronze springs to help them to shut, and is worked by a lever (SS, Plate XXIV) with a cross handle, the stroke of the handle being limited in the holes through which it works by stops. The pump is fixed to the recoil cylinder because the cylinder oscillates on its trunnions when the gun rises and falls; otherwise it would be necessary to connect the pump to the recoil cylinder by flexible suction and delivery pipes. The pump has a constant stroke of 4 inches, but to obtain this under the varying positions it is thrown into by the oscillations of the cylinder, it is necessary to make the pump longer by 2 inches, or the amount of the oscillation. Stop valves are fitted to the suction or delivery pipes of the lowering pump, and to the recoil cylinder, to enable repairs, &c, to be executed to the lowering pumps without blowing off the pressure from the cylinder; they are metal castings, fitted with phosphor-bronze spindles, and have the words "open" and "closed" marked on the valve spindle gland. The pump transfers the liquid from the inner cylinder to the air-chamber of the recoil press. The weight of the gun assists this action, so that the work of the pump is only to reduce the pressure under the recoil ram till the gun can descend by its own weight.

Cut-off Gear.

The cut-off gear (T¹ and T, Plate XXIV) is provided in order to make sure that the raising valve gets moved towards the closed position, as the gun nears the firing position, so that the gun's speed may be gradually checked. The cut-off is not intended to entirely close the valve, although the chain may be screwed up short enough to make it do so, but this is not recommended as it involves loss of time, the speed being so extremely slow towards the last. The valve is intended to be finally closed by hand, and may with care be entirely so worked, if the cut off gear happens to be damaged or out of order. The chain of the cut off gear is attached to the cross-head and to the rocking carriage, these points are so chosen, that if the buffer in the cross-head comes into action, the cut-off chain is not drawn tighter by the extra forward movement of the gun, because the part attached to the cross-head slackens as much as the part attached to the carriage is overdrawn. There is a right and left hand coupling to the cut-off chain for the adjustment of the length, and check nuts to fix it when adjusted.

The chains of this gear will, in the event of the existing gear being found to fail, be replaced by a rod with slotted link.

Securing Gear.

The securing gear (XX, Plate XXIV) is fitted for holding the gun down, so that the carriage may be left without fear of the gun rising, which might happen either from the valve being left partially open, or from interference with the hand lever by unauthorised persons. It consists of a pair of hooks, which are hinged to the main girders of the lower carriage, and can be hooked over the flanges of the beams of the rocking carriage. These hooks are made with a set screw at the top, the point of which can be screwed into a shallow hole in the flange of the beam of the rocking carriage, so that when put in place they cannot well be undone without a spanner of the right size. When in use both hooks are intended to be used at the same time.

CARRIAGE, GARRISON, DISAPPEARING, B.L., 9-2-INCH,
MARK II.*

(Plates XXIX and XXX.)

The body of the carriage consists of a pair of steel beams connected together so as to form a solid frame A. Towards the middle of the lower side of the frame is a pivot plate fitting on to a pivot piece B securely bedded in the masonry or concrete of the emplacement.

The outer ends of the frame are carried on two pairs of cast-iron wheels or rollers C, travelling on a roller path embedded in the floor of the emplacement.

On the upper side of the frame towards the middle are secured a pair of cast steel pedestals D, which carry a steel rocking shaft E, on to which are keyed a pair of bent wrought-iron elevators F, the upper ends of which are formed into bearings for the trunnions of the gun and fitted with capsquares.

The lower ends of the elevators are connected by a wrought-iron shaft G, round the middle of which is clasped the outer end of a connecting rod H, the opposite end of which abuts into a recess in the bottom of a hollow trunk or plunger I, which works into the horizontal recoil cylinder J through a gland packed either with leather or hemp packing.

The plunger is a little smaller in diameter than the cylinder, but terminates in an enlargement or piston which fits the bore and serves at once as a guide, an automatic throttle valve, and a stop to prevent the ram being forced out too far.

The cylinder is of cast steel, and is secured to the side girders of the main frame.

On the rear end and top of the cylinder J, are two automatic recoil valves, which communicate, by means of the pipes L, with two steel-plate air vessels K,† placed horizontally one on each side of and over the cylinder.

When the gun recoils the connecting rod H and plunger I are forced into the cylinder, and the liquid with which the cylinder is filled, is driven through the recoil valves into the air vessels, compressing the air contained in the latter. The recoil valves being "non-return," the liquid cannot return through them to the cylinder.

NOTE.—The letters F², G², H², I² and M² represent the parts designated by F, G, H, I, and M, when the gun has recoiled into the loading position.

Leading from the lower sides of the air vessels to the recoil cylinder is a pipe controlled by a screw stop-valve; and, on opening this valve (the gun having recoiled and the air in the vessels being compressed), the liquid in the air vessels is forced back by the compressed air into the cylinder, driving out the plunger and connecting rod before it, and thus by means of the elevators, lifting the gun into the firing position. As the gun nears the firing position, a port, which controls the passage of the liquid into the cylinder, gradually closes, and the gun is brought gently to rest.

* Originally called Easton and Anderson (E. and A.) Mounting.

† These vessels are not shown in Plates, in order that the cylinder J may not be hidden. The two holes L and L (Plate XXX) represent the pipes leading to the air vessels, cut across.

Buffers are provided to check the gun, both in its downward and upward movements.

The elevating arrangement consists of an elevating band secured to the breech end of the gun, to which are attached a pair of elevating bars M, the lower ends of which are attached by elastic connections to a shaft which crosses from side to side of the frame, the ends of which are fitted into racks N, working into guides secured to the inner faces of the girders forming the frames. The racks are elevated by gearing, and the two racks are worked simultaneously by spur wheels actuated by handwheels O on either side of the carriage. A graduated scale indicates the degree of elevation of the gun. A friction clutch is introduced so as to avoid sudden shocks to the gear.

To soften the jump of the carriage at the moment of discharge, the front end of the main frame is fitted with short stroke hydraulic compressors the piston rods of which are attached to the brackets secured to the frames, and the cylinders to clips which embrace the head of the rail which forms the roller path.

The compressors act both ways, that is, they will resist the upward jump of recoil and will also lower the carriage gently after the motion of the gun has ceased. The compressed cylinders are solid at the bottom, so that the liquid used once filled in cannot leak out.

The traversing of the carriage is effected by handles P on each side of the frame, which actuate the front wheels or rollers by means of suitable gearing.

Two pairs of pumps, one for water and one for air, are placed in the front transom, and are actuated by a cross shaft and hand wheels Q on each side. These pumps are intended for forcing air or water into the air vessels, or for lowering the gun from the firing into the loading position; this is effected by pumping the water from the cylinder into the air vessels.

The pumps are thrown in and out of gear with the cross shaft by means of forked clutches S, acting on the wheels, and a slow and quick gear is provided for each pump.

The water pump is provided with two suctions, which can be opened or closed by means of stop valves. When facing to the rear the valve on the right opens communication between the pump and the recoil cylinder, and is used when pumping down the gun into the loading position; that on the left opens to a flexible hose, which is used to draw from a bucket when more water is required in the cylinder.

On the front end of the right air vessel is fixed a Bourdon pressure gauge, and also a dead-weight gauge.

This consists of a plunger fitting in a stuffing box, and held down by a bridle, on which are hung weights; each weight gives 100 lb. per square inch on the plunger.

On the front of the left air vessel is a glass water gauge. When the gun is down, the water should stand at a line marked on the glass. These gauges are covered by sliding lids; as a rule they should be kept shut off from the air vessels.

The men attending to the traversing, elevating, and pumping are protected by the parapet. The projectile is brought up on a barrow, and raised to the level of the gun, by a derrick at the left rear of the carriage. A sighting platform, with ladder and handrail, is fixed to the left side of the carriage, to enable the gun to be laid by means of the service sights. The following are the principal dimensions:—

Diameter of gun pit at top	34.0 feet.
" " " " bottom	40.0 feet.
Depth to upper surface of racer	13.0 inches.
Fall of gun vertically	9.0 feet.
Length of trunnion path	14.3 inches.
Diameter of recoil cylinder	32 inches.
Stroke of " "	3 feet 11 $\frac{3}{4}$ inches.
Air pressure—gun up	238 lb. per sq. inch.
" " down	407 lb.
Water level distance below top of base of gauge glass.	48 inches.

TRAY, SPARE PARTS.

This is made of deal or pine, and sub-divided into compartments, similar to the "box spare parts" for the gun, *see* page 21, of such a size as to hold the necessary spare parts to be kept for the number of carriages in the work.

The tray is made locally.

CARE AND PRESERVATION OF CARRIAGES AND SLIDES.

See "Regulations for Magazines and the Preservation of Artillery Matériel."

SPECIAL INSTRUCTIONS NOT IN THE ABOVE MENTIONED REGULATIONS.

Shafts and spindles having nuts secured by taper pins will be marked to correspond with each other to prevent the nuts being placed on the wrong shafts or spindles. When necessary, nuts, shafts, or spindles will be marked locally, with a letter or punch mark as most convenient.

Whenever any parts are found broken, defective, or deficient, which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice should be at once reported, with a view to being made good without delay.

Covers for the protection of the cams of auto-sights will be provided locally.

Care, &c., of Barbette Mountings.

Mark I.

To Mount the Slide.—The slide (with clips removed) must be carefully lowered on to the roller path, care being taken that it is directly over the pivot, so that the pivot pin enters the bush fairly. The clips must then be replaced.

To Mount the Carriage.—Remove the front and rear clips from the inside of the carriage, and draw the outside front clips out to clear the flange on the slide. Then lower the carriage (with piston rod) gently on to the slide, bolt on the clips, and secure the piston rod to the slide.

The directions for repacking the hydraulic buffer are the same as for Mark II mounting.

Mark II.

If the buffer leaks at the gland, the latter must be tightened up. If this will not stop it the packing must be renewed.

To Renew the Packing.—Run the carriage back about 2 feet, and block it in that position. Empty the buffer by removing the run-off plug on the underside. Unscrew the gland and slip it along the piston rod, to admit of the defective packing being extracted and replaced by the new, which must be well saturated with Russian tallow before insertion.

If the leather packing requires renewal, it will be necessary to disconnect the piston rods from the slide before running back the carriage to do this, take out the securing pins in the front nuts on the piston rods and remove these nuts from each rod, run the carriage back, block it, and remove the inner nuts from the rods, unscrew the stuffing box and remove it and take out the old leather. The new leather must be thoroughly greased and carefully placed upon the rod, so as not to damage the edges, and well pressed home by the metal stuffing box before inserting the cotton packing.

In reconnecting the piston rods with the slide, care must be taken to replace the parts so that the adjusting gear for the buffer will be in working order.

To Fill the Buffers.—See that the carriage is hard against the front stops, and that the run-off plugs are screwed tight home, remove the filling plugs, insert the gallon measure in one of the filling holes, run in sufficient fluid to fill the cylinders (about 12½ gallons for each buffer). To draw off a small quantity of the fluid, the draw-off plugs should not be unscrewed more than a quarter of an inch, as the fluid will flow through small holes drilled in the plugs for that purpose. To empty the buffers these plugs must be unscrewed entirely. The buffers may also be filled by using the running-back pump for this purpose: if this method be preferred, connect the delivery pipe of the pump to the filling hole of the right cylinder, see that the release valve is closed, remove the filling plugs from the pump cistern and pour in the fluid, work the pump till the fluid overflows at the filling hole of the left cylinder, replace the plug in this hole, and work the pump till the carriage begins to move, replace the plugs in the pump cistern. The working contents of this pump is 6 gallons.

To alter the size of the piston openings, slacken back the nut in front of the hand lever, and move the lever until the required amount of adjustment is indicated on the scale. The jamming nut must then be tightened up.

The mountings must be lifted on the hydraulic pivot from time to time. Care must be taken that the liquid in the pivot, tank, and connections is clean and free from grit. The liquid used is 65 lbs. of glycerine per mounting (rather more than 5 gallons). The pump valves and seatings must be examined occasionally and cleaned, this can be done by removing the screw plugs over the valves. The leather packings in the plungers and stuffing boxes, and washers under the plugs and in the unions, must be renewed when found necessary. Should the amount of vertical lift in the pivot be insufficient, it can be increased by adjusting the length of the outer link connecting the pivot band with the pump, the exact amount of lift can be seen on the index provided for the purpose. If the mounting should at any time be removed from the pivot, the greatest care must be taken to protect the pivot ram and cylinder from abrasion.

The band round the pivot block must be periodically lubricated. This band must on no account be disconnected, or the joint pins withdrawn from the supporting frame, unless the carriage is dismounted and the slide properly blocked up, but this should only be necessary when the mounting is being removed.

To Run the Carriage back by Pump.—Hook the lifting derrick provided into the hole made in the top of the right hand side of the carriage, and hang the chain blocks on the end of the derrick, lift the pump into its place and clamp it down with the screws provided for that purpose. Connect the delivery branch of the pump with the filling hole of the right hand buffer by means of the connecting pipe provided.

To Run Back.—See that the release valve under the pump cistern is closed, and work the pump handles.

To Run Up.—Open the release valve.

As the running back gear is only provided for purposes of drill it should be removed before commencing firing practice.

The running back pump must be examined occasionally to see that the valve seatings and other important parts are in good order; the valves can be got at by removing the plugs in the cistern, and in the bodies of the pumps.

The leathers in the stuffing boxes, unions, and on the plugs must be renewed when necessary.

To Dismount the Carriage.—Disconnect the buffer rods from the slide, and the front clips from the carriage, remove the rear buffer spindles from the slide. Run the carriage back until it is in contact with the rear buffer stop brackets: the rear clips will then pass through openings in the upper flanges of the slide girdles, made specially to admit of the removal of the carriage.

Mark III.

Before the erection of the mounting is commenced special attention must be directed to the following points:—

- (a) The racer must be perfectly level.
- (b) The roller path, upper and lower teeth of traversing rack, rollers, and the underside of the rack where the clips engage, must be quite clean, and free from burrs.
- (c) It should be seen that the roller ring has not been bent.

The rollers and axles must be oiled, placed on the roller ring, and the ring given two or three revolutions on the roller path before putting on the mounting, to make sure that it runs truly.

The upper roller path should be cleaned and oiled, and any burrs removed, the mounting should then be lifted into position. The traversing gear and pointer should then be attached, and one or two revolutions made to see that the mounting traverses truly. The level of the racer may be tested here by a spirit level placed on the mounting. Put on the clips and make another revolution to ascertain that they do not bind on the clip ring. The angular segment plates connecting the front and rear bolsters, and carrying the side platforms and ladders, should be fitted before placing the slide on the ring.

Particular care must be taken that the elevating band, elevating arc, and pinions are put together correctly, or otherwise damage may occur. The friction clutch in the worm wheel should be tightened just sufficiently to prevent the elevating arc running down itself when the gun is mounted. The clutch consists of alternate plates of steel and metal, and their surfaces should be slightly oiled. The

gear should be elevated and depressed frequently to prevent the trunnions adhering to the bearings.

Before connecting the piston rods to the slide, they should be pushed in and out to see that they work freely, and that the packing glands are not too tight.

To Mount the Gun.—When the gun has been placed in the trunnion holes, secure the elevating band and arc in position, insert the cap-squares and secure them by pins, and fix the ball bearings in position on the spindles. Then raise the gun on its ball bearings until it pivots freely in elevating; they should be slightly lubricated only.

Hydraulic buffers.—Before removing the buffer glands for renewal of the leathers and packing, the gun must be run back to the most convenient position. The lengths of packing should be well greased before use, taking care that when putting them in, the joints of the packing rings do not come opposite each other. Great care should also be taken in putting in the L leathers in the buffer glands, to see that the edges enter properly without being damaged.

In cases where it is found that the guns do not run up to the front stops, a flat surface will be filed on the controlling plunger, or screw plug of controlling plunger, to allow of the gun running up to the stops without violence.

To Prepare for Firing.—Run the carriage out to the front stops, then remove air plugs from both cylinders, and pour in oil through one hole until it overflows at both, and draw off $\frac{1}{2}$ pint, i.e., $\frac{1}{4}$ pint from each buffer, then replace plugs.

Contents $9\frac{1}{2}$ gallons.

Mark IV.

The instructions for the care of the Mark III mounting will generally apply to the Mark IV, except buffer gear. And in addition the following:—

Gun Attachments.—To prepare the gun for mounting:—Place the lower half of the gun band in position. Over the trunnions of the gun place the sliding blocks, which are of H section, at the same time seeing that the front ends of the blocks overlap the lower half of the band; then secure the blocks to the band by the steel screws. Place the upper part of the band in position and bolt up.

To Mount the Gun.—Remove the guide clips from the cradle, release the piston rod from the front brackets of the cradle, and push back the buffer tube with piston rod until there is a clearance of about 3 feet from the front end of the bracket. Place the gun with its attachment in the cradle, refix the clips to the sides of the cradle, then pull the buffer tube forward until it engages with the gun band, and secure the piston rod to the front transom. It may prove more convenient to force the buffer tube forward by slight air-pressure pumped into the air-chamber.

When the cradle is mounted in its bearings on the carriage, secure the elevating arcs to the sides of the cradle, screw on the cap-squares, and fix the ball bearings in position as for Mark III mounting.

To Prepare for Firing.—Charge the intensifier and main gland by pumping in oil at "A," which is at the left side of intensifier, let air escape at "C," which is on top of air chamber near the front. The piston rod of the intensifier may also be forced in by a screw clamp, and the oil then poured in at plug "A."

Charge the air chamber through valve "D," which is at the rear of air chamber, to a pressure of 200 lbs. per square inch. About 3 quarts of oil should be in the air chamber.

With the gun at elevation, fill the buffer with oil by pumping in

at "E," which is at the underside of buffer cylinder, near the front, let air escape at "B," which is on top of buffer cylinder and over valve "E."

Contents $9\frac{1}{2}$ gallons.

Mark V.

Before the erection of the mounting is commenced, special attention must be directed to the following points:—

(i.) In cases where $132^{\circ} 30'$ traverse on either side of the centre line passing through the front and rear of the emplacement is required, it must be noted that the centre line of the key way for the pivot plug should be $2\frac{1}{4}$ inches to the left rear of the centre line of the emplacement. Where more than this traverse is required, the telescopic exhaust pipe should be replaced by a splanter grip hose, and the traverse should be limited by means of the traversing stops.

(ii.) The stops for limiting the angle of traverse, which are to be fitted locally, must be so arranged that when the springs on the traversing stops are compressed, the telescopic exhaust pipe is clear of the centre pivot pipe bend.

(iii.) The instructions as to level of racer, correctness of upper path, and live roller ring before mentioned will also apply to this mounting.

To Mount the Carriage.—The carriage is mounted on the live roller ring, the centre pivot in position, and the clip plates secured; the carriage should then be given two or three revolutions to see that it works correctly.

To Mount the Cradle.—Mount the cradle in its trunnion bearings, the elevating arcs being previously attached, screw on the capsquares and fix the ball bearings in position on the end of the trunnions. Attach the hydraulic pipe to the swivel joint on the left hand trunnion.

To Mount the Gun.—Before mounting the gun it must be raised on to skidding, to allow the lower half of the gun bands to be placed in the correct position. Place the upper parts of the bands to exactly correspond with the lower parts, and secure them inflexibly together by the clips on the sliding bars; the latter connect the front and rear bands, and are secured to them by steel screws.

The gun with its attachments is now ready for mounting. Remove the guide clips from the cradle, and push the compressor rams into their cylinders. Run back the buffer tube on the piston rod until it has a clearance of about 12 inches from the front stops. Place the gun with its attachments in the cradle, refix the clips to the top of the cradle, secure the lower cap on the front band, also the nut on the recoil buffer stuffing box, and the compressor rams to the lugs on the front band; it may prove convenient to force the buffer tube into the recess on the lug of the front band, by slight air pressure pumped into the air chamber.

Fill the buffer tube in strict accordance with the instructions on the plate on the side of the cradle.

The service buffer oil is used in the buffer, which will be invariably kept filled, and before filling care should be taken that the gun is within 2 inches from the front stops. Before replacing the air-hole plug it should be seen that as little air as possible remains in the buffer. This may be minimised by raising the gun a few degrees from point blank while filling the buffer. To ensure the controlling ram chamber being full of liquid, slacken the gland on the front end of the piston rod, and pump in liquid until it passes the gland.

No permanent alteration should be made in the pressure laid down for the air chamber, and it should be noted that the pressure indicator is giving correct record.

Before firing it should be ascertained by removal of the air screws in the compressors, that the latter are full of liquid, to ensure the accumulator being properly charged during recoil. It is also important that the lever of the distributing valve for the front and rear hoists is in the central position, and all valves are properly tight upon their seatings.

Packings.—By pumping liquid into the buffer cylinder, the gun may be run back to a convenient position for removal of the small gland and the renewal of the hydraulic packing; but for renewal of the L-leather the buffer of course must be emptied and the stuffing box removed, the gun being properly secured in a suitable run-back position. The packing is the service "hydraulic"; it is woven square in section with a rubber core, and is supplied by length. For use it is cut into full lengths, which are prepared and adjusted in the usual way.

The ball bearings of the cradle trunnions should be properly adjusted and kept well lubricated.

For care and preservation of the electric cables, *see* page 78.

To Prepare for Firing.—Charge the intensifier and main gland by pumping in oil at the valve marked "A," which is on the right side of air chamber near the rear, let air escape at "C," which is on top of air chamber near the front. The piston rod of the intensifier may also be forced in by screw clamp (for description, *see* page 45), and the oil then poured in at "A," using a funnel.

Charge the air chamber through valve "D," which is at the rear of air chamber, to a pressure of 200 lbs. per square inch, about 3 quarts of oil should be in the air chamber.

With the gun at elevation, fill the buffer with oil by pumping in at valve "E," which is at the under side of buffer cylinder near the front, letting air escape at "B," which is on top of cylinder over "E."

Contents of—

Hydraulic buffer ..	9½ gallons	} of service buffer oil.
Accumulator tank and compressor system, about	35 "	

Care, &c., of Disappearing Carriages.

The instructions as regards the live roller ring, detailed for Mark III "barbette" mounting, will apply to the disappearing carriages also fitted with a roller ring.

Adjustment of Valves.

(Plate XXV.)

The adjustment *Mark I recoil valve* is dealt with in paragraph 64I, Regulations for Magazines, &c.

Mark II recoil valve (fig. 3).—This valve can be adjusted without the pressure in the cylinder being let out. To adjust the valve, remove the cover (a), keep screw (b), stop (c), and turn the valve spindle (d), until the pointer (e) corresponds with the required graduation on the index plate (f). The index plate is graduated in

20 divisions, each representing $\frac{1}{100}$ of an inch lift to the valve. After the necessary adjustment has been made, replace the stop, keep screw, and cover.

Adjustment of raising Valve and repacking its Gland (fig. 1).— The gland of the spindle of the raising valve can be repacked without blowing out the compressed air from the recoil cylinder. If, however, there is a leak from the outer chamber to the inner through the raising valve itself, the pressure must be let out before the valve spindle (a) or its seating can be looked to.

To repack the gland, fasten the elevator down by the clips, and take off the nut (e) on the end of the valve spindle. Remove the stop nut from the end of the rack (f), pull out the rack, and remove the bracket (g) and toothed wheel (d) from the valve spindle. The gland nut (e) can now be unscrewed, and the gland repacked, care being taken not to disturb the gland box (b) unless for the purpose of replacing the lead packing (l), when the pressure must be let out and the gland box screwed up again before the packing of the gland commences. In doing this care should be taken not to use too much force, as the gland box is rather weak. In replacing the gland nut, it should not be more than a quarter of an inch from "home."

Replace the toothed pinion, bracket, and nut, pinch the top of the pinion round from left to right until it can be moved no longer (taking care that it is not bearing against the gland nut), which will show that the valve is bearing against its seating; then pinch it back sufficiently from the right to left, drop in the rack, and screw in the stop at the end of it; connect up the link in the cut-off shaft to the top of rack. Replace the cover of the bracket, release the holding-down clips of the elevator and let the gun rise carefully. When the gun is "up," readjust the cut-off chain or rod with slotted link.

ELECTRIC FIRING GEAR.*

Battery and Key, Test and Firing

The firing key and battery is designed to serve two purposes:—

- (i) To test the tube and circuit when the gun is made ready to fire.
- (ii) To fire the tube.

To enable this to be done an indicator is fitted within the firing key itself, which is so arranged that when the handle or knob is turned to the right the current passes through the indicator and the rest of the gun circuit, and if this is complete a visible and audible signal is given. If it is then required to fire, the knob is pressed in, which action cuts the indicator out, and allows the full current to flow through the circuit, firing the tube.

An arrow is cut on the face of the knob of the key in such a position that when the arrow is upright, the knob is in the safe position. The arrow is painted white and when vertical the circuit is broken, and the gun cannot be fired.

Besides this the apparatus may take the place of the Menotti cell and galvanometer for testing tubes and firing wires.

* See footnote,* page 74.

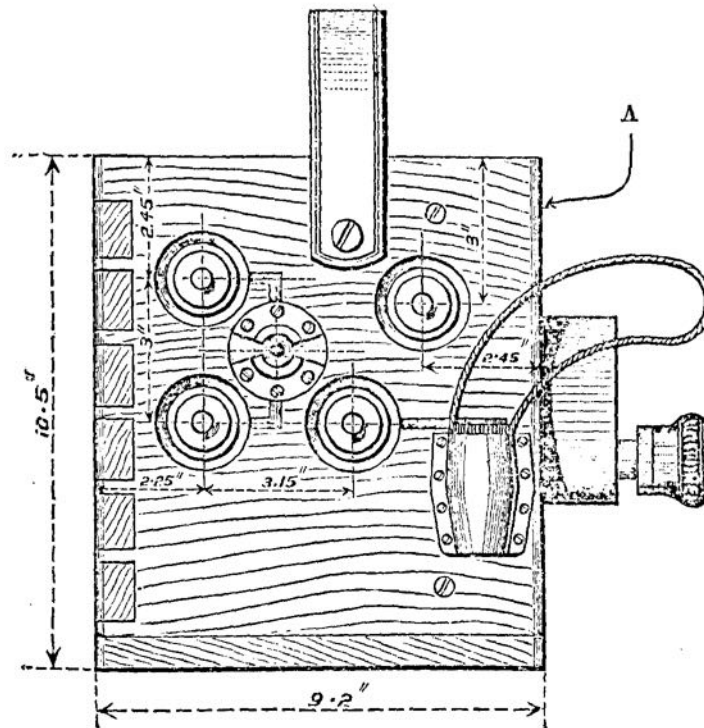
The Leclanché cells, of which there are two in the battery box, are issued with the sal-ammoniac in them; all that is required to make them ready for use is to fill the cells two-thirds full with water, and to see that this is added from time to time to make up for evaporation.* See care and preservation, page 78.

The apparatus is suitable for firing any low tension fuze or tube through a short length of wire, about 50 yards of No. 16 copper wire (0.065 inch diameter).

Mark III** battery is generally as shown in (Fig. 1), and a diagram (Fig. 2) is affixed to the case showing the internal and external connections.

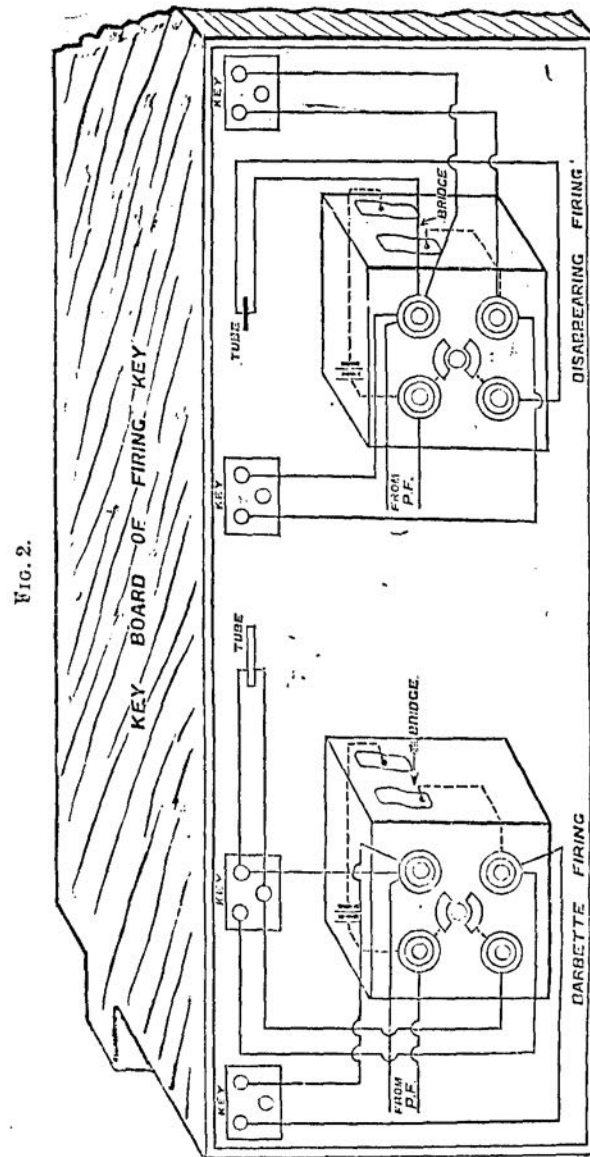
Mark IV battery differs from Mark III** in having the four terminals placed nearer to each corner of the box, the firing plug between the two left-hand terminals, the case for firing plug in the centre of side of box, *i.e.*, when the plug is not in use, and the wires from the terminals to the cells are embedded in the sides of the box instead of being flexible. The cells can be removed from the box by disconnecting the wires.

FIG. 1.

Scale $\frac{1}{4}$.

A.—Diagram of connections fixed on front of top block, as shown in Fig. 2.

* This refers to O.P. cells, which will be replaced by Le Clanché cells, A, Mark III, which will be issued filled and sealed. See also footnote, page 78.



Precautions to be observed.

Before any wires are attached to the key, care should be taken that the arrow on the knob points upwards, and the key should be tried to see that it works freely and correctly.

The firing wires must not both be connected up until after the gun is laid and ready to fire, and the front is clear. The turning of the knob should be done just before it is required to fire, and it may either be held turned or not, as desired, until the gun is fired by pressing it in.

The following rules will detect the particular cause of failures to fire with electric tubes :—

(1) If the indicator works properly and yet when the knob is pressed the tube does not fire, the fault is a short circuit between the firing leads, or in the tube itself.

(2) If the indicator works feebly only, some bad joint in the circuit will be the probable cause.

(3) If it does not move at all the circuit is broken at some point in the wires, or in the tube itself.

(4) If the indicator works when the knob is turned and the gun does not fire when it is pressed, and then when the knob is turned again the indicator does not work, this shows that the tube has fired without igniting the charge.

To eliminate faulty tubes it is as well to test them before use, out of the gun. This should be done under precaution, so that in the case of a tube being accidentally fired, no damage would ensue. The firing leads may also be tested; and the apparatus may be considered to be in good order if on joining the terminals with a short piece of wire and turning the knob the indicator works well. If it should only work feebly the battery should be examined, as in this case it will not give sufficient current to fire with certainty.

*Arrangement of Leads for Electric Firing, Barbette Mounting.**

The leads from the position-finder firing circuit, terminate at the P.F. safety firing plug or dial box recess. From thence a length of "cable electric, D 9†," is led through an iron pipe placed under ground, by the most convenient route, to the junction terminal box. This box, which is of cast-iron, contains two terminals, and is fixed in the floor of the emplacement, flush with the concrete, on the centre line of the arc of fire, and as near as possible (but varying with the mark of mounting, and must be arranged locally) to the centre of the pivot.

The iron pipe is attached to the nozzle on the box provided for the purpose and the joint made watertight. The two wires of the D 9 cable are attached to the back of the terminals on the terminal board by means of brass nuts.

Another length of D 9 cable is attached by open washers (soldered to the ends of the wires) to the terminals in the box, and is passed through the gunmetal gland in the lid and thence through an open-ring staple to the terminals D and F, on the "Battery and key, test and firing," to which the wires are attached by open washers, similar to those mentioned above, *see* fig. 5.

The open-ring staple is fixed to the slide in such a position as to enable the cable to be conveniently led to the "Battery and key, test and firing," which is situated on the side of the slide.

The length of the cable is to be such that sufficient slack is left below the open-ring staple to admit of the full traverse of the mounting.

The terminals E, G on the "Battery and key, test and firing," are connected to the terminals attached to the firing-key bracket, which is described below, by permanent leads of "Wire, covered, C 8" or D 9 cable provided with open washers at each end, attached to the mounting by brass staples screwed on as stated below for emplacement and P. F. firing, respectively.

* Mark V barbette carriage has a special electric firing system, which is described with the carriage. Probably this will apply to Marks III and IV barbette carriages also.

† D No. 13 single core covered cable for future use.

The route followed by these leads is to be that most convenient for each mark of mounting.

From the terminals B and C on the firing key bracket a length of cable, electric, D 10*, with open washers for attachment to the terminals, and points to fit the tube wires completes the circuit to the tube. During loading this lead is to be hung over the rail out of the way.

The firing key bracket, referred to above, is fixed to the hand-rail on rear of slide, convenient for the firing number. It is fitted with three binding screws (see Fig. 5), marked "Tube," "Battery," "Tube battery," the latter only being required when the bracket is used on "barbette" mountings. A spring is attached to the back of the terminals, marked "Tube" and "Battery," respectively, for making contact with the firing key. When the firing key is not required in the bracket, a wooden slide or circuit connector (Figs. 3 and 4) fitted with a brass spring is placed in the bracket for completing the circuit.

FIG. 3.

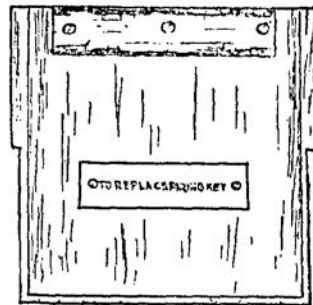
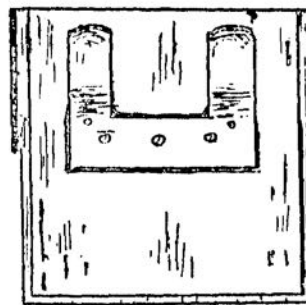


FIG. 4.



Wood slide of firing key bracket.

Slides fitted with a firing key bracket on both sides, the leads being "in parallel," it is important that it should be clearly borne in mind that only one circuit connector or wood slide is to be used, which should be either in the battery or in one of the firing key brackets. The bracket not in use will be left vacant, as should a circuit connector or wood slide be inserted while one is already in the battery, the circuit would be completed and the gun prematurely fired when the safety plug is inserted.

Instructions for Arrangement of Leads.

(Fig. 5.)

For emplacement firing.—The two leads from the tube in gun are connected to the terminals B and C. Permanent leads are placed from A to G and from C to E. The circuit is then complete and only requires the insertion of the plug P to enable the gun to be fired. The firing plug must be removed from the socket on the board of P. F. safety firing plug, if one is installed.

For firing from position-finder.—A third permanent lead is fixed from B to F, and the two leads from the position-finder circuit are

* D No. 13 single core cable for future use.

attached to D and F respectively. The insertion of the plug P then enables the gun to be fired. The firing-plug must be inserted in the socket on the board of P.F. safety plug, if one is installed.

When the firing key is placed on its bracket care must be taken to place the wood slide taken from the bracket in the receptacle in the battery box from which the firing key was taken.

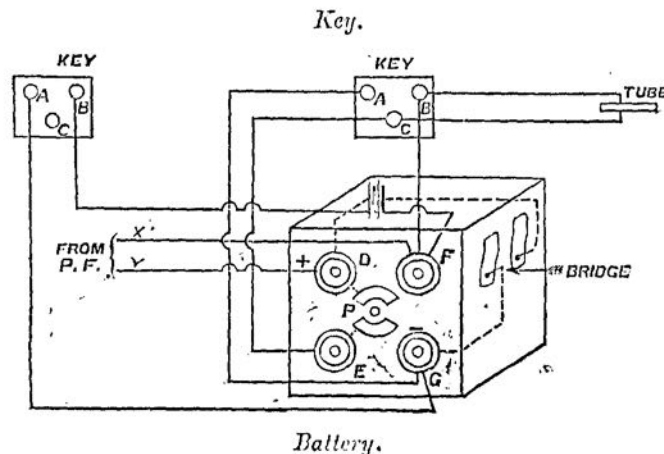
If the key be turned for test, with the firing plug P removed, the firing plug inserted in the socket on the board of P.F. safety firing plug, and the switch handle of the dial-box at FIRE, the indicator not working shows that the firing relay in the dial box is not "lifted."

If the key be turned for test with the firing plug P inserted and the switch handle of the dial-box not at FIRE, the working of the indicator shows that the tube circuit is in good order. It is immaterial whether the firing plug is removed from the socket on the board of P.F. safety firing plug or not.

Lead X, fig. 5, must be taken to the right hand binding screw of the P.F. safety firing plug, or to the terminal marked PLUG on terminal board B, if no safety firing plug is installed.

Lead Y, fig. 5, must be taken to the left hand brass binding screw of the P.F. safety firing plug, or to the negative pole of the P.F. firing battery, if no safety firing plug is installed.

FIG. 5.



The terminals A, B, C are lettered thus:—

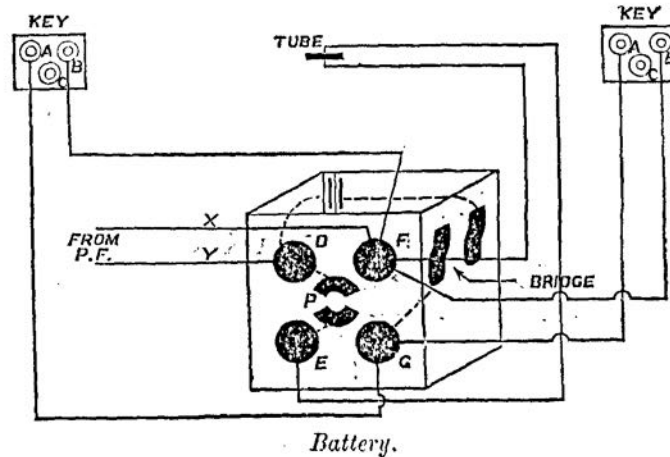
A BATTERY B TUBE, C BATTERY
 (red) TUBE

These terminals are on the back of the firing-key bracket, and protected by a hinged cover.

Arrangement of Leads for Electric Firing, Mark I, Disappearing Mounting.

The connections will be arranged as shown in fig. 6.

FIG. 6.



The lengths of C 8* and D 9* required will depend on the position of the P.F. safety firing plug or dial box recess, and firing key bracket (which is described under "barbette" mounting), and must be stated in local demands.

For carriages fitted with two firing key brackets, the leads being "in parallel," the instructions at page 75 for slides so fitted will also apply.

Instructions for Arrangement of Leads.

For emplacement firing from sighting platform using service sights in gun.—A length of "wire, covered C 8," will be secured to the terminals A and G, by an open washer at each end, soldered to the conductor, another length will be fixed to B and F, and similarly secured, or one length of "cable, electric, D 9" may be used instead, the twin cable being separated and the ends connected as for the C 8. The terminals A and B are on the back of the bracket to hold the firing key, the bracket being situated on the hand-rail in a convenient position for the gun layer to manipulate, without obliging him to lose his sighting (see p. 61). The "cable, electric, D 9" is led by the most convenient route from the contact bracket on the breech face of the gun, and permanently secured in position by clips attached to the gun and mounting. To prevent accidents by premature firing, the twin cable (D 9) is divided at a bracket near the lower end of the elevator, one division is fitted with rubbing contacts (one on the lower carriage and one on the elevator), which automatically complete the circuit by coming in contact only when the gun is in the correct position for firing, the other division of the line is passed under the end of the round joint pin, and the lines are again joined at a bracket and led to the battery on the lower carriage. The ends of the two conductors from the gun will be connected by open washers to E and F.

For emplacement firing from manhole using shield sights.—The arrangements are similar to firing from the sighting platform, except that a lead of D 9 cable passes through the shield at the right side of front manhole, and secured along under the shield, down left rear standard, and across the carriage, in rear of the girders to the electric

* D No. 13 single core cable for future use.

battery. The cable is connected to the terminals as shown in Fig. 6. Care must be taken that the slide (Figs. 3 and 4) referred to at p. 75, is in its place in the bracket when the firing key is not, so that the electric circuit may be complete.

For Firing with the Position-finder.—The leads from the position-finder firing circuit terminate at the P.F. safety firing plug or dial-box recess. From thence a length of "Cable, electric, D 9," is brought down the side of the emplacement through the pipe in the floor to the pit, and up through a hole drilled in the corner of the chequered footplate at the point where the circular girder joins the side girder of the carriage; the cable will then be separated for a short distance and connected to the terminals D and F by open washers soldered to the ends of the conductors. Sufficient of the "cable, electric, D 9" must be left in the pit to allow for the full traverse of the carriage, and in the case of a mounting permitting of all-round fire, care must be taken to traverse back in the opposite direction to which it came (and not necessarily by the shortest route), so as to avoid the liability of fouling or breaking the cable in the pit. The leads X Y will be arranged as for "barbette" mounting.

When the firing key is placed on its bracket, care must be taken to place the wood slide taken from the bracket in the receptacle in the battery from which the firing key was taken.

The tests of circuits can be made as for "barbette" mounting.

CARE AND PRESERVATION.

Battery.

The two closed Leclanché cells are issued with the sal-ammoniac in them; all that is required to make them ready for use is to fill the cell two-thirds full of water, and to see that this is added from time to time to make up for evaporation.*

When the battery fails to fire a tube, fresh sal-ammoniac (about 4 ozs. to each cell) should be added, the old solution being thrown away.

The cells are insulated by being painted or paraffined; either process protects them from accumulations of films of damp, dust, or dirt, or depositions of salt out of the liquid, due to what is termed "creeping." To keep the cells secure in the box on the gun being fired, &c., packing pieces of asbestos are placed between and round them, and a wood saddle is placed in the box over the cells.

To prevent "creeping" all cells should be kept dry and clean, and for this reason they should be enclosed in painted or varnished boxes.

The connections of the battery must be kept bright.

Wires.

Electric wires or light cables should be perfectly free from kinks, and insulated to prevent as much as possible waste of current. They are issued sheathed in insulating material; but joints should be covered or insulated with the materials as allowed by Equipment Regulations.

In making joints the ends should be prepared by being thoroughly cleaned by scraping, or with emery cloth or sand paper.

* This refers to O.P. cells. Le Clanché, A, Mark III cells are issued filled and sealed, and when found to be defective will be returned to A.O.D. for examination, and will be at once replaced by new cells. See "Regulations for Magazines, &c."

PUMP, RUNNING BACK, PORTABLE, MARK I.
CARRIAGES, GARRISON, B.L. 12-INCH, 9·2-INCH, MARKS III, IV AND
V BARBETTE.

(Plate XXXa)

This pump is used for running back the above mentioned carriages at drill, &c.; it is of the ordinary double-acting hydraulic type, and is designed so that the liquid pressure will act on the pistons of the hydraulic buffers. It is contained in a portable tank, on wheels, so that it may be conveniently moved from one carriage to another.

The pump itself consists of a metal casting (*a, a*) fitted with plungers (*b, b*), which, when actuated by the handles (*c, c*) through (*d*), draw the liquid through the inlet valves (*e, e*), and force it past the delivery valves through the hose or the pipe into the hydraulic buffers or buffer, as the case may be; the pressure acting on the pistons of the buffers causes the carriage to run back. When run back, the carriage can be retained in that position by closing the stop valve on the buffer.

When in use with the 12-inch and 9·2-inch Mark III carriages it is connected by the sphincter grip hose to the stop valve screwed into the filling hole of one of the hydraulic buffers of the carriage; for the 9·2-inch Marks IV and V carriages the copper connecting pipe is used.

Before commencing to pump a carriage back, the tank must be filled to a depth of 6 inches with the same description of fluid as is used in the hydraulic buffers.

When the carriage is run in, the liquid is forced back again from the hydraulic buffer to the tank through the return valve (*f*); this valve must be closed before commencing to pump the carriage back, and opened to run up.

Weight 5 cwt. 1 qr.

The following articles, referred to above, are used with the pump, as indicated opposite them :—

PUMP, RUNNING BACK, PORTABLE, MARK I—

HOSE	Sphincter grip, 17 feet, with couplings and stop valve; B.L., 12-inch and 9·2-inch, Mark III, barrette.
PIPE CONNECTING ..	Copper with fittings; B.L., 9·2-inch, Marks IV and V, barrette.

PUMP, AIR OR GAS, MARK I.

(Plate XXXI.)

The pump, which is designed to be driven by engine power, is intended primarily for charging reservoirs for hydro-pneumatic mountings with compressed air.

Pump.

The pump consists of four cylinders of different diameters, each fitted with a plunger and connected by copper pipes (*a*); it is placed in a tank of water to keep the working parts and the air cool when charging.

The cylinders are metal castings, about 14 inches long, and are numbered 1, 2, 3, and 4; their respective diameters being $5\frac{1}{2}$, $3\frac{1}{2}$, $1\frac{1}{2}$, and $\frac{1}{2}$ inches. The differences in diameter admit of the air being compressed in stages, and ensure an approximately equal amount of work on the plungers when in operation. Each cylinder is packed with a U leather ring and hydraulic packing, the latter being compressed by a gland which is tightened from above by bolts. After the glands are packed, a small quantity of water is let into the cylinders through a valve to cover the joint and ensure a perfect sealing.

The cylinders are strengthened by a series of ribs running around them; they are in pairs (Nos. 1 and 3 in one pair, Nos. 2 and 4 in the other), and are bolted together in the centre, the whole, when in position, being supported by two steel standards (*b*), connected by diagonal cross stays (*c*). The upper ends of the standards are formed into bearings to take the crank shaft (*d*).

The plungers are of metal, and are cast hollow (except No. 4, which is solid and made of aluminium bronze), with an opening at the lower end of each, so that the cooling water may be in close contact with every part. They are worked by two forked connecting rods of metal (*e*), which are secured by caps to the cranks of the shaft. The lower ends of the connecting rods work in guides (*f*), to maintain the vertical motion, and are attached by caps to two cross heads, to which the plungers are fixed by bolts.

The copper pipes are connected to the cylinders by means of inlet and outlet valves contained in valve boxes (*g*), which form part of the cylinder castings. Both valves have coned seatings and are similar in form, but the inlet valve after each stroke, returns to its seating by its own weight, while the outlet valve has a small spiral spring above it to ensure its return after the air has passed. The two pipes connecting Nos. 2, 3, and 4 cylinders are in long spiral coils, so as to present a greater surface to the action of the cooling water, and at the lower end of each coil is attached a small drain pipe, the upper end of which is connected by a union to a drain cock (*h*); this cock, when opened, allows any accumulation of water in the pipes to be blown off.

The valve box on No. 4 cylinder has two projections cast on it at right angles to each other; one projection forms a connection for the delivery pipe, the other is fitted with a coned relief valve (*i*), which is loaded by means of a spiral spring so adjusted that when the safe maximum pressure has been reached it will rise, and thus allow the air to escape.

The crank shaft (*d*), which is in one forging of steel, is fitted at each end to take a driving pulley. Both pulleys have an 8-inch face, but one is 3 feet 6 inches in diameter, and the other 2 feet 6 inches, so that the number of revolutions can be altered as required by shifting the position of the driving belt.

The tank (*k*) is of steel plate strengthened with angle pieces and galvanized; two parallel angle pieces are rivetted along the top ends, with holes bored through to suit $1\frac{1}{2}$ -inch holding-down bolts (*l*), by which the tank is secured. A metal draw-off cock is screwed into the lower end of the tank.

The holding-down bolts will be made locally.

Extractor.

The extractor, which is for removing the coned seating of the valves, consists of a steel spindle, four cones, nut, collar, bearing plate, and key.

The spindle is 8 inches long, with a $\frac{1}{2}$ -inch screwed thread at one end, and a $\frac{3}{8}$ -inch screwed thread ($\frac{5}{8}$ inch long) at the other; in the centre is formed a square, to which are attached, by means of a sliding cross-head, two hinged arms (each $3\frac{1}{2}$ inches long) with a small projection at the end. The cones have each a $\frac{3}{8}$ -inch screwed thread in the centre for attachment to the spindle. The nut is hexagonal with a $\frac{1}{2}$ -inch thread in the centre. The collar is $1\frac{5}{8}$ inches in diameter, and the bearing plate $4\frac{1}{2}$ inches by $1\frac{5}{8}$ inches. The key is 6 inches long with a square hole in one end to fit over a square cut on the spindle.

Method of Use.—A cone (to suit the seating to be extracted) is placed on one end of the spindle, and the bearing plate, collar, and nut on the other; the arms and spindle are then passed through the seating, so that the projection at the end of the arms will engage with the underside of the seating, and the bearing plate will rest on the top of the valve box. The screwing down of the nut (the spindle being kept from turning by means of the key) extracts the seating from its bearing.

Maximum working pressure, lb. per square inch, 2240.

PUMP, AIR OR LIQUID, MARK I.

(Plates XXXII and XXXIII.)

The pump is double-acting, and is intended for charging the cylinders of hydro-pneumatic mountings with fluid or compressed air, and reservoirs with compressed air. It is contained in a metal tank (*a*) 2 feet $0\frac{1}{2}$ inch in length and 1 foot $2\frac{3}{4}$ inch in width, bolted to an iron stand, which is secured to a wood platform.

The pump consists principally of the following parts:—

- (1) High and low pressure plungers; the former (*d*) is fixed to a crossbar (*e*) at the top of the tank, having a gunmetal washer inserted between the seating and the L leather, and the latter (*f*) to the bottom of the tank.
- (2) Suction, intermediate (*h*), and delivery valves.
- (3) Metal cylinders (*g*), formed at one end to receive the high-pressure plungers, and at the other the low-pressure plungers.
- (4) Outer plungers (*i*).
- (5) Overflow valves (*k*).
- (6) Cock (*l*) for admitting air or liquid to the pump.
- (7) Double-handle lever for actuating the cylinders (*g*).

Stand.

The stand, which is of cast iron, 7 inches high, is attached to a wood platform, 5 feet 9 inches long by 3 feet $5\frac{1}{2}$ inches wide.

Adapter, A.

This adapter, which is for use with the connecting pipes of the "Pump, air, double," is a metal casting 2.625 inches long, with connections to suit the discharge nozzle of the "Pump, air or liquid," and the unions of the connecting pipes of the "Pump, air, double."

(9784)

F

Adapter, B.

This adapter, which is for use with the connecting pipes of the "Pump, air or liquid," is a metal casting, 4.45 inches long, with connections to suit the unions of the connecting pipes of the "Pump, air or liquid," and the "Connection, indicator, pressure," in use with hydro-pneumatic mountings.

Pipes, connecting.

These pipes are each 10 feet long, two with unions at each end, and two with a plug at one end and a union at the other.

Spanners.

The spanners, Nos. 157 to 160, are of steel, formed to suit the various parts of the pump, &c.

Arrangement of Connecting Pipes.

The pump is connected to the recoil cylinder of hydro-pneumatic mountings, or to reservoirs, by means of connecting pipes, which may be either those described above, or the connecting pipes of the "Pump, air, double," whichever are available.

When the connecting pipes of the "Pump, air, double," are used for connecting to the recoil cylinder or reservoir, through a separator, the adapter "A" is first screwed on to the discharge nozzle of the "Pump, air or liquid," and the pipes are then connected as required.

When the pipes of the "Pump, air or liquid," are used for connecting—

1. To the recoil cylinder, the adapter "B" is first screwed on to the "Connection, indicator, pressure," in use with the mounting, and the pipes are then connected as required.
2. To the reservoir through a separator, three adapters, "B," are first screwed on, one to the nozzle of the inlet valve, one to the nozzle of the outlet valve of the separator, and one to the nozzle of the valve of the reservoir; the pipes are then connected as required.

Method of Use.

Pumping Air.—When charging with air, the lever working the cock (*l*) is turned to the side of the tank marked "air." On the up stroke of the cylinder, air is drawn through the cock, along the passages, and through the suction valve into the low-pressure cylinder (*n*). On the down stroke of the cylinder the air is forced through the intermediate valve (*h*), and compressed into the high-pressure cylinder (*o*), and on the next stroke of the cylinder is forced through the delivery valve and pipe (*p*) to the cylinder of the mounting or reservoir.

When first commencing to pump air, the area of the low-pressure cylinders can be increased, and, consequently, a larger volume of air pumped, by connecting the outer plungers (*i*) to the bottom of the tank. When the pressure is found to be too high for the pump to be worked by this arrangement, the outer plungers (*i*) are connected to and move with the cylinders (*g*). The outer plungers (*i*) are con-

needed to the tank or cylinders by moving a lever on each side of the tank towards the words "low pressure" or "high pressure" respectively. *The connections must not be made until the cylinder is on the bottom stop on that side.*

Pumping Liquid.—When pumping liquid, the lever of the cock (l) is turned to the side of the tank marked "liquid," and the plug of the overflow valve is unscrewed sufficiently to admit the liquid in the tank into the low-pressure cylinder (n). On the up stroke of the cylinder, the liquid is drawn through the intermediate valve (h), which in this case becomes the suction valve, into the high-pressure cylinder (o), and on the down stroke of the cylinder is forced through the delivery valve and pipe (p) into the cylinder of the mounting.

Weights, &c.

	Weight. cwt. qr. lb.	Tonnage. Tons.
Pump	3 0 0	0.3695
Stand, with platform ..	3 2 3	0.451
Maximum working pressure, lb. per square inch, 2,000.		

PUMP, AIR, DOUBLE, MARK I.

(Plates XXXIV and XXXV.)

The pump is intended to charge the recoil cylinders of disappearing garrison mountings with fluid or compressed air.

It consists of two gunmetal cylinders (A and B) of different diameters in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank (C) for the fluid while being pumped into the recoil cylinders. The pump cylinders are fitted with plungers (D), actuated by a rocking lever (E), which is supported on brackets (F) rivetted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate (G), which is secured to the floor by clips (H) and cottars (I). It is worked by two T handles, which are attached to the rocking levers, and are connected at the top by a link to ensure uniform action.

When charging the recoil cylinders with fluid, the fluid is drawn through suction valves from the tank into the large pump cylinders (A), and on the down stroke of the plunger is forced into the small cylinder through delivery valves. When charging with air the connection between the tank and the cylinders is cut off by closing the valves (K) near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open liquid is drawn in in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary, and worked independently; the delivery of either is cut off by closing the delivery valve. When this is closed, of course the handle must be disconnected, so that the pump cut off may not be worked.

The pump should be kept in store with the tanks full of liquid, and so used whether air or liquid is being pumped.

To keep the leathers in good order they should be slightly under pressure. To obtain this, screw one length of the copper tubing on the delivery nozzle (J), and on to the other end of the tube fix the blank cap (with packing leather). Then work the pump with the water valves closed until it becomes difficult to move the handles, when the pump may be left—the air in the tubing serving to maintain the pressure obtained.

When standing long in store the pump should be tried occasionally, to see that the pressure is still on.

A cover is fitted to the iron bedding plate to protect the small pipes which connect the base of the pump to the three-way connection.

When it is found that the cylinders of the pumps are defective from excessive wear and scoring, they will be bored to a larger diameter, according to the amount of wear, and fitted with new plungers, and L leathers. The thickness of the cylinders will not allow, at the most, of more than 0.15-inch enlargement, and this amount must not be exceeded. On the enlargement of a cylinder, the word "large" will be stamped on the new plunger.

Weight, 4 cwt. 1 qr.

Maximum working pressure, lb. per square inch, 2,800.

RESERVOIR COMPRESSED AIR,* MARK II.

(Plate XXXVI.)

The reservoir is for keeping in reserve a supply of compressed air for re-charging the cylinders of H.P. mountings. It is in the form of a flask, with a short neck at one end, fitted with a stop-cock (a), which is used for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe; the stop-cock is in two pieces, so that the pressure in the reservoir can be cut off, and the outer part (b) removed when the reservoir is packed for transport.

The pressure in the reservoir should not exceed 2,000 lbs. on the square inch when in ordinary use.

It should be remembered that more work will be got out of a reservoir, if it is opened to the cylinder with the gun up, than with the gun down, and in getting up pressure from zero with the aid of reservoirs, it will be done more quickly if the gun is allowed to rise.

A preserving plug, valve union, and valve key with gland are issued with the reservoir.

Care and Preservation of Reservoir, Mark II.†

As the reservoirs have to sustain a high pressure when fully charged, it is essential that they should be periodically tested to ascertain if they are in a serviceable condition, and annealed to preserve the tenacity of the material.

The testing will be carried out locally biennially, by pumping in‡ hydraulic pressure up to 3,750 lb. per square inch; any reservoirs

* The Mark I reservoir is not so strong as the Mark II; it is not issued for service with these carriages.

† See Regulations for Magazines, &c.

‡ From the "Pump, testing compressed air reservoirs," now approved.

failing to pass this test, or showing any permanent set or leakage, must be returned to store for transmission to Woolwich. *Before and after* testing, the outside of the reservoir near the centre must be accurately gauged at four points, and the measurements recorded on a history sheet, which is supplied with each reservoir; the date of the biennial test must be stamped on the reservoir.

The reservoirs will be annealed every sixth year, for which purpose they must be returned to store for transmission to Woolwich.

Each reservoir will have a registered number stamped on it, also the manufacturing Mark or name, the numeral of the reservoir, date of issue, and annealing and test marks, with date as follow:—

No. 56	The stamping of the date of test on the reservoir must
J. B. and Co.	on no account be done until the pressure has been
II	let out. A history sheet (Army Form G 881) will
1899	be issued with each reservoir. This sheet is intended
(A) 10.3.99	to preserve a complete history of the reservoir from
(T) 11.3.99	the date of issue from the Royal Arsenal to its final

return to store. The biennial tests and re-annealing will be recorded on this sheet, and also anything calling for special remark. The sheet must always be kept with the reservoir, and returned with it to store. Report of the entries made in the sheet are to be sent to the Chief Inspector, Woolwich, through the G.O.C. on the completion of the biennial testing.

Filled reservoirs on R.A. charge should be marked with the word "filled," and with the amount of pressure in them.

Before returning reservoirs to store, they must be first emptied, and the word "empty" stencilled on them.

Reservoirs not on R.A. charge should be stored empty, and so marked.

Care must be taken when removing reservoirs that they are not thrown down or roughly handled. To protect them from jar, three 4-inch tarred rope grumets will be placed on the reservoirs; and in hot climates, wadmiltits, or such other suitable covering as may be available, will be used, when required, to protect them from the rays of the sun.

SEPARATOR, AIR PUMP, MARK I.

Plate XXXVI.

* The separator is used to separate the moisture from the air during the process of pumping into the reservoir. It consists of a copper tube, $1\frac{1}{2}$ inches in diameter and 3 feet long, screwed at both ends. At one end of the copper tube a wrought-iron head (c) is fitted, furnished with inlet and outlet valves of gun-metal, and a $\frac{1}{2}$ -inch copper pipe, which carries the air and water in a downward direction into the separator. At the other end of the copper tube is a wrought-iron foot which is fitted with a drain-cock (d) of gun-metal. The separator is connected up between the pump and the reservoir to be charged, and the moisture of the air, while passing through the copper tube (e), falls to the bottom and is blown off from time to time during the operation through the drain-cock. When the separator is used, it must be always fixed in a vertical position, the inlet and outlet valves being at the top.

INDICATOR, PRESSURE, SPRING.

(Plate XXXVII.)

The indicator shows the pressure per square inch in the recoil cylinders of H.P. mountings.

It consists of a metal cylinder (*a*) screwed into a metal casing (*b*) which contains a steel spiral spring, and on the exterior of which is fitted a dial (*c*). At the lower end of the spiral spring is a piston which works in the cylinder, and is connected by a small chain to a drum, on the spindle of which is fitted a pointer (*d*). A flat steel spring is wound around the drum, and fixed to it, so as to cause it to revolve directly the chain is slackened.

The pressure acting on the piston, overcomes the resistance of the spiral spring in proportion to the pressure obtained; this movement slackens the chain, and allows the flat spring to turn the drum with the pointer (*d*), which at once indicates the pressure on the dial (*c*). This dial is graduated to record from 0 to 2,000 lbs. per square inch.

The packing for the piston is special; it consists of finely shredded asbestos fibre, mixed with tallow, and pressed into a recess in the bottom of the piston, by means of a rammer supplied for that purpose. Spare packing is issued in a brass box.

The indicator, with the necessary spanners, packing, and instructions, is issued complete, packed in a wooden box.

NOTE.—It has been decided to replace the above-mentioned indicator by "gauges, pressure (Bourdon), Nos. 1 to 4" which are available for pressure lb. per square inch from 0 to 350, 350 to 1,000, 1,250 to 2,000, and 1,800 to 4,500, respectively.

CONNECTION, INDICATOR PRESSURE.

(Plate XXXVIII.)

The indicator is attached to the recoil cylinder of the mounting by the intervention of a three-way connection, one opening of which (*a*) screws into the filling cock, the opposite one (*b*) takes the pump tube, and the centre one (*c*) the indicator. (When the indicator is not on this opening it is closed by the closing plug (*f*) the nut (*h*) fitting either the plug (*f*) or the foot of the indicator. There is a cut off (*d*) worked by a spindle (*e*) which closes the way to the indicator, while leaving the passage free between pump and cylinder. The way to the indicator should not be left open while pumping or firing is going on, as the indicator is liable to suffer. When it is desired to leave the indicator on, and detach the pump pipe, the bared nozzle of the connection is closed by a blank cap (with leather washer) supplied.

In connecting the indicator it is not necessary that it should be absolutely vertical, an inclination of 10° or 15° is admissible.

The indicator is issued in a box with two spanners.

CONNECTION, FOUR-WAY, AIR PUMP.

(Plate XXXVIIIa).

Mark I four-way connection is made of gunmetal, and has a plug, lead washer, loop, and chain; four caps, each with leather disc, loop, and chain.

The connection is to admit of the use of more than one pump when charging the recoil cylinders of hydro-pneumatic mountings with fluid and compressed air; it has four unions, three of which are available for the connecting pipes of three pumps, and the fourth for the pipe leading to the recoil cylinder. If less than three pumps are employed, caps are placed over the unions not in use. It is not used with the "pump, air, or gas."

By working the pumps simultaneously, the charging of the cylinders is greatly accelerated.

The connection will be allowed in the proportion of "1 per work" in which hydro-pneumatic carriages are located.

GAUGE, PRESSURE, DEAD WEIGHT TESTING.

(Plate XXXIX.)

This is issued to test the accuracy of the indicator records.

The indicator is screwed on to the connection at one end, and fluid pressure applied by means of a plunger (*e*), driven by a hand-wheel (*f*) at the other end. A safety valve weighted by means of a lever (*g*) which supports marked weights (*h*), rises when the pressure per square inch marked on the weights is obtained; the indicator (*c*) should then show this pressure. It should be noted that the lever bed plate, &c., for the weights, counts for 200 lb. (per square inch) in addition to the weights applied.

The liquid employed is the same as that used in H.P. cylinders, and it is poured into the reservoir (*i*) from time to time as required. There are two cut-off valves (*k*) and (*l*), one to the indicator and one to the reservoir. As the stroke of the plunger is small, the liquid has to be drawn from time to time from the reservoir without losing the pressure, and this is effected by the judicious manipulation of these valves, the indicator being cut off by screwing up the valve (*k*) and the reservoir connected when the plunger is being withdrawn, and the reservoir cut off by the valve (*l*), and indicator connected when the plunger is being screwed in. The reservoir should be kept covered while in use to prevent dust getting into the liquid.

Care should be taken not to shake the instrument while the pressure is on, as it is liable to make the safety valve act prematurely, and so vitiate the results.

There are several leather joints and packings which require attention. Spare leathers are issued in a small tin box in the case, together with the necessary spanners, and special instructions as to packing the piston, &c.

AMMUNITION.

CARTRIDGES.

(Plates XL to XLIII.)

Gun for which used.	Nature.	Cartridge.	When filled.	
			Length not to exceed	Diameter not to exceed
B.L., 9.2 inch, Marks—			inches.	inches.
Ic and Ic c ..	{	35-lb. prism ¹ , brown, $\frac{1}{4}$ charge	9.25	10.85
		21-lb. cordite, size 30, $\frac{1}{4}$ "	19.0	{ 7.5 large end. 5.3 small end.
IV to VIc ..	{	41-lb. prism ¹ , brown, $\frac{1}{4}$ "	9.25	11.7
		26 lb. 12 oz. cordite, size 30, $\frac{1}{4}$ charge	19.5	{ 7.5 large end. 6.0 small end.
IX ..	{	50-lb. cordite, size 44, $\frac{1}{4}$ charge	33.0	{ 8.25 large end. 6.4 small end.
		25-lb. " " " $\frac{1}{4}$ "	16.5	{ 8.25 large end. 6.0 small end.
IX to X ^v ..	{	51 lb. 8 oz. cordite, sizes 44 and 3 $\frac{1}{4}$, $\frac{1}{4}$ charge	33.0	{ 8.25 large end. 6.7 small end.
		25 lb. 12 oz. cordite, sizes 44 and 3 $\frac{1}{4}$, $\frac{1}{4}$ charge	16.5	{ 8.25 large end. 5.9 small end.
.. ..	{	Aiming { rifle { electric ..	over all	body base
		{ tube	5.0	1.098 1.219
			5.2	1.1 1.226
			0.87	0.355

CARTRIDGE, 35-LB.

The 35-lb. prism¹ brown cartridge is made of No. 3 class silk cloth; the body is prismatic, with polygonal ends shaped to fit the form of the built up prisms; a primer of black powder is inserted at each end of the cartridge to facilitate ignition. In the centre of each end there is a hole 3.75 inches in diameter, covered with silk netting, over which the shalloon disc is fastened by shellac, a piece of broad silk braid is sewn on to each shalloon disc for the purpose of tearing it off before loading. It has also six broad silk braid hoops which keep it in form, thus making a good firm cartridge.

Two beackets made of silk braid are sewn on the top and bottom for the purpose of lifting the cartridge. When 80-lb. cartridges have been converted to 35 lb., the designation will be Mark I*. Packed 2 in a zinc cylinder.

CARTRIDGE, 41-LB.

The 41-lb. prism¹ brown cartridge is similar in construction to the last mentioned. Packed 2 in a zinc cylinder.

CARTRIDGE, 21-LB.

The 21-lb. cordite cartridge is of No. 2 class silk cloth, with six hoops of 0.65-inch silk braid. It has a lifting beacket of 1-inch braid at the small end; the large end has a silk cord beacket, which passes

through the centre of the cartridge and tied to a silk braid loop, secured to two silk cloth discs in the small end of the cartridge. The charge of cordite is built up, tied with silk twist, and placed in the bag, an annular space being left at one end of each charge for a primer of 8-oz. R.F.G.² or new blank F.G. powder, contained in a ring formed by silk cloth and shalloon laid over the end of the charge, and sewn to the bag, the end being entirely covered; the primer is stitched across in four places. The cartridge is closed by silk netting,† millboard, and silk cloth discs; the silk netting and silk cloth discs are sewn to the bag; the millboard disc has a silk cloth disc attached to it, both being ripped off before loading; a red binding loop, marked "Tear off," being attached for the purpose. The primed end of the cartridge should be placed next to the vent in loading. Packed 1 in a zinc cylinder.

CARTRIDGE, 26-LB. 12-OZ.

Mark I 26-lb. 12-oz. cordite cartridge is similarly constructed to the 21-lb. one, but owing to the larger charge of cordite, the contraction is nearer the small end, and the primer is contained in a ring of silk cloth and shalloon (the front half cloth and the rear half shalloon); the ring being placed in the recess, the end of the whole charge is not covered with shalloon. When this cartridge has a shalloon disc stitched entirely over the primed end, on top of silk netting where it exists, is designated Mark I*.

Mark II is similar in construction to the 21 lb. cartridge.
Packed 1 in a zinc cylinder.

CARTRIDGE, 50-LB.

The 50-lb. cordite cartridge is similar to the 21 lb. cartridge, excepting—

- (a) Dimensions.
- (b) There are 10 hoops of silk braid 0.65 inch wide.
- (c) A 1.5-inch wide silk braid lifting becket is stitched to the bag in four places near the primed end, in addition to the 1-inch becket at the small end.

However, no more cartridges of this description will be made.
Packed 1 in a zinc cylinder.

CARTRIDGE, 25-LB.

This is similar to the 50 lb. cartridge, but it has only 5 braid hoops, and not the 1.5-inch extra becket.

No more will be made.
Packed 2 in a zinc cylinder.

CARTRIDGE, 51 LB. 8 OZ.

As shown in the Plate, this cartridge generally differs from the previous patterns of cordite cartridges in being made of two different sizes of cordite, the smaller size being wound spirally in alternate directions round a central core of cordite, and tied with silk twist wound in a similar manner. It has 10 hoops of silk braid 0.65 in. wide.

Packed 1 in a zinc cylinder.

† The silk netting is now omitted in making up cordite cartridges.

CARTRIDGE, 25 LB. 12 OZ.

This cartridge is made in a similar way to the $\frac{1}{2}$ charge of 51 lb. 8 oz. It has 5 braid-hoops.
Packed 2 in a zinc cylinder.

CARTRIDGES, DRILL.

Dummy cartridges are issued for drill purposes.

For Marks Ic. and Iv.c. Guns.

35 lb., *Mark I.*—This represents the service prism cartridge, $\frac{1}{4}$ charge. It is of wood, brought up to weight by a ring of cast-iron in the centre; the cartridge is covered with raw hide, and a rope grammet is fitted at each end.

21 lb., *Mark I.*—This is similar in shape to the service cordite cartridge, $\frac{1}{2}$ charge, and is of wood, weighted with lead in the centre; it is covered with rawhide. A lifting becket of Preller's lace leather is fitted at the small end, and a loop of the same material is fitted at the large end.

For Marks IV to VIc. Guns

41 lb., *Mark I.*—The cartridge is of similar make to the 35 lb. drill cartridge above mentioned.

26 lb. 12 oz., *Mark I.*—This is similar to the 21 lb. drill cartridge before mentioned.

For Marks IX to XV Guns.

51 lb. 8 oz., *Mark I.*—This drill cartridge represents the service cartridge, $\frac{1}{2}$ charge; it is similar in manufacture to the 21 lb. drill cartridge before described.

CARTRIDGES, AIMING-RIFLE, 1-INCH, ELECTRIC, FOR USE WITH BREECH-PIECE HAVING ELECTRIC HEAD.

The Mark II case is of solid drawn brass, having in its base an electric primer made of three tubes, which fit into one another, the central and intermediate ones being insulated from one another by means of goldbeater skin round the body of the former, and a vulcanized fibre washer under its head. A platinum-silver bridge, round which is a tuft of guncotton, connects the ends of the central and intermediate tubes, the space beyond the bridge in the intermediate and outer tubes being filled with fine grain powder. A conical brass plug closes the mouth of the inner tube to prevent the escape of gas. The head of the inner tube is raised in the centre to form a contact point, and round it is a ring of insulating material. The case is charged with 400 grains R.F.G.² powder, over which are placed wads, and a pointed bullet of hardened lead, secured to the case as for the percussion cartridge.

Mark IV, M, Mark IV, KN, differ from Mark II in having an electric primer consisting of a brass outer tube, two ebonite insulating plugs, and a brass contact pin. An aradio-platinum wire

bridge is soldered, one end to the point of the contact pin, the other end to the circumference of the tube.

In order to facilitate identification of the pattern of primer used in the manufacture of Mark IV cartridges, the letters "M" or "KN" will, in manufacture, be stamped on the cartridge and printed on the wrapper after the numeral, to indicate that the primers are made, respectively, to the Morris, or King's Norton Company's pattern.

CARTRIDGE, AIMING-RIFLE, 1-INCH, PERCUSSION, FOR USE WITH BREECH-PIECE HAVING PERCUSSION HEAD.

Mark I, the case is of solid drawn brass, having the cap, chamber, and anvil formed in the base; the cap is double, the outer of brass, the inner of copper. Three fire holes in the cap chamber enable the flash to pass from the cap to the charge. The charge consists of 465 grains of M.G.¹ powder, or 400 grains R.F.G.², on top of which are placed wads and the bullet. The bullet is of lead, pointed; it is secured to the case by indenting the latter in three places into the lower of three cannelures.

These cartridges are packed 96 in a "Box, ammunition, S.A., G.S." in bundles of 12.

Weight of box, filled, about $97\frac{1}{2}$ lb.

CARTRIDGES, AIMING-TUBE.

Mark I case is of solid drawn brass with a cap chamber and anvil in the base; two fire holes in the anvil allow the flash to pass from the cap to the charge, which is $3\frac{1}{4}$ grains, "Curtis and Harvey's Diamond, No. 2" powder; over it are wads and a bullet of pure lead.

Mark II differs in the arrangement of the wads.

Packed 100 in a cardboard box, and issued, usually, 10,000 in a tin-lined box.

STACKING, &c.

See "Regulations for Magazines, &c."

PROJECTILES.
(Plates XLIII to XLIIIc.)

Nature.	Mark.	Bursting charge.		Total weight; filled and fuze in the case of shell.	
		Weight.	Powder.		
Shells, B.L., 9·2-inch—Common—		lb. oz.			
Iron	<div> <div>I, I*, II, II*, VII</div> <div>III, III*</div> <div>IV, IV*, V, V*, VI</div> <div>I, II</div> </div>	18 0	P. and F.G.†	380	
Forged steel		33 0	"		
Cast steel		30 6	"		
Lyddite		40 0	Lyddite		
Common pointed—					
Iron	<div> <div>I, II</div> <div>I, I*, II, III, IV, V</div> <div>I, II</div> <div>V, VI, VII</div> </div>	12 4	I.G. Salt	380	
Cast steel		12 4	"		
Armour-piercing ..		30 0	P. and F.G.†		
Shrapnel		18 0	"		
Shot, B.L., 9·2-inch—Armour piercing—		2 3	"		
Steel	<div> <div>I, I*, II, III</div> <div>II, III</div> <div>IV</div> <div>V</div> </div>	..	..	380
Paper {		in two parts, 1 front and 1 rear	380
		in four parts, 3 front and 1 rear	
			428

† In the proportion of 4 lb. P. to 10 oz. F.G. powder.

To avoid premature explosion through friction when the powder sets back on the shock of discharge, bursting charges of cast-iron common shell are contained in serge or dowlas bags, of forged steel, in serge, of cast steel, in silk cloth or dowlas bags; and of common pointed and armour-piercing shell, in dowlas bags.

Projectiles not fitted with the gas check driving band, now generally have the front slope of the driving band serrated or roughened to prevent the projectile slipping back when loading the gun at elevation.

For description of Palliser shot, which may still be in equipments, see previous issue of handbook.

COMMON SHELL.

Marks I and II shell are of cast iron, and shorter than those hereafter described; Mark I has the narrow and Mark II the broad driving band, and both have the small base plug covered by the lead disc. An asterisk after the numeral of the shell indicates that they have been fitted with the "driving band with gas-check." When the groove for driving band is undercut, the iron shell will be known as Mark VII.

Mark III is of forged steel with a solid base; length, 33.5 inches.

Mark III* differs from Mark III in having the driving band with gas-check.

Mark IV is of cast steel similar to Mark V, but with a large base plug and no adapter, hence not suitable for a base fuze; the junction of the plug is closed by a lead ring the same as is used for the adapter.

Mark IV* only differs from the Mark IV in having the driving band with gas check.

Mark V is made of cast steel with bands; its base is rounded with a radius of 0.2 inch. The head is truncated and struck with a radius of two diameters; it has a flanged bush tapped to the G.S. gauge, and provided with the recess for naval wad. The interior is lacquered. There is a hole in the base 1.8 inch in diameter, fitted with a base plug with lead washer under the head. Some shells have, for convenience of manufacture, the hole in the base 2.6 inch diameter which is closed by a gunmetal adapter fitted to take the plug. The use of this adapter is optional with the manufacturer. There is an undercut recess round the flange of the adapter and in the metal of the shell, into which a lead ring is hammered to close the joint, the adapter not being removed for filling the shell. On the exterior of the shell, and in line with the centre of gravity, is a lifting hole tapped for the reception of the eye-bolt used for lifting projectiles. The shell is fitted with a broad Vasseur driving band having three cannelures.

It is 33.58 inches long, 9.32 inches diameter over driving band, and weighs, filled and fuze, 380 lb.

Mark V* is the Mark V fitted with driving band with gas check.

Mark VI differs from V* in the base being closed with a steel plug, which is secured in as tightly as possible, and the joint rivetted up, and the groove for driving band is undercut to prevent the band stripping off.

COMMON SHELL, LYDDITE.

Mark I shell is of forged steel, 3.65 calibres long; the base is solid, and rounded to a radius of 0.2 inch; the head is struck with a radius of two diameters, the point being truncated and fitted with a gunmetal bush, which is tapped to G.S. fuze hole gauge. The interior of the shell is varnished.

An undercut groove is turned in the body near the base, into which is pressed the copper driving band with gas check to impart rotation to the shell. The front slope of the gas check portion of the band is serrated or roughened to grip in the bore and to prevent the shell slipping back into the chamber when loading the gun at elevation; the band has two cannelures.

The shell is filled with lyddite, with a 4½-oz. picric powder, Mark I exploder and a Mark II primer of 8 drams R.F.G.² powder, the exploder and primer are each contained in a shalloon bag, and both are enclosed in a waterproof paper cylinder 16.1 inch long, the choke of the primer being placed downwards in the cylinder.

Mark II shell differs from Mark I in the form of lower part or grave of driving band, *see* Plate.

COMMON SHELL, POINTED.

The common pointed iron shell, Mark I, is similar to the pointed steel shell, but the walls are much thicker, and consequently the cavity for bursting charge is less. It has the driving band with gas check, and the groove for the band is undercut.

The common pointed iron *practice* shell, Mark II, differs from Mark I, before mentioned, in dimensions only. The base is fitted with the large base plug. Shells of this description are issued unlacquered, and filled with salt; they are painted with a yellow band (denoting practice) round the body, and stamped with the letter "P" on the base.

The cast-steel shell, Mark I, differs from the cast-steel common shell principally in having a pointed head and a fuze-hole in the base, which is suitable for the "Fuze, percussion, base, large, No. 11."

Mark II differs from Mark I in having the "driving band with gas-check."

Mark III differs from Mark II in having the groove for driving band undercut.

Mark IV steel shell differs from Mark III in the cavity for bursting charge, which is carried up more to the point; and the base which is closed with a steel plug, screwed up as tightly as possible and the joint rivetted up.

Mark V shell differs from Mark IV in the form of lower part or groove of driving band, *see* Plate.

ARMOUR-PIERCING SHELL.

Mark I is of forged or cast-steel, the head is brought to a point, and the base is prepared to take the "fuze, percussion, base, large, No. 11." A steel bush may be used in closing the base at the option of the maker; if so, it must be screwed up as tightly as possible and the joint rivetted up.

The shell is fitted with the gas check driving band, the groove for it being undercut to prevent the band stripping off.

Mark II differs from Mark I shell in the form of lower part or groove of driving band, *see* Plate.

SHRAPNEL SHELL, *see* footnote.*

ARMOUR-PIERCING SHOT.†

The Mark I shot is made of hardened steel, with bands 9.15 inches in diameter. It is fitted with a broad Vavasseur driving band of copper, 9.32 inches in diameter provided with three cannelures. The head of the shot is struck with a radius of two diameters and the base rounded off with a radius of 0.2 inch. The interior is hollowed out, but no bursting charge is used, and the base closed with a plug. Armour piercing shot are weighted up with sand-shot and sawdust.

An asterisk after numeral indicates that the shot have been fitted with "driving band gas-check."

Mark II differs from Mark I in having the "driving band gas-check" attached on manufacture.

Mark III differs from Mark II in having the groove for driving band undercut.

* Shrapnel shell will be met with in certain equipments.

Mark V. shell differed from Mark VII. in the form of drivingband, and when the groove for driving band was undercut, the shell became Mark VI.

Mark VII. is of cast steel, 3.55 calibres long, radius of head is 2 diameters, the bursting charge is in the base. The head is secured in the usual way, and has a socket of G.S. fuze hole gauge. The form of driving band is as for the Mark II lyddite shell. The shell is lined with brown paper, and it contains about 638 2-oz. sand shot.

† Will be used up for practice, and no more will be issued for land service.

PAPER SHOT.

Mark I is made up in two parts, each part consisting of a cylinder of rolled brown paper, choked at top and bottom to elmwood discs; the bottom disc being weakened by holes partially bored through it, so that it may break up on firing.

The total weight of the shot is brought up to that of the service projectile, by each cylinder being weighed up to 190 lbs. with "Shot waste, 1 to 5" and sawdust; the filling being done through a hole in the top disc, which is then closed with a wood plug.

The cylinders forming a shot are marked "Front" and "Rear" and are used as their names imply. The part marked "Rear" has its bottom disc larger in diameter than the bore, and is in consequence stopped on ramming home, when its rear end reaches the commencement of the bore, in order that the shot may not be rammed home too far.

Mark II differs altogether from Mark I in appearance and construction. The cylinders are made entirely of papier mâché of a hard, black, polished surface on the exterior, ribbed discs of papier mâché taking the place of the wood discs in Mark I. The method of filling and the enlargement of the base of the "Rear" cylinder are, however, the same as in the Mark I.

Marks III, IV and V are similar to Mark II, except that the cylinders are made of wood pulp, and the discs are stouter. However, Marks IV and V are heavier than the previous Marks, and Mark V is shorter and in four parts.

The shot are to be fired with powder charges only.

As they break up on firing, the small shot travel but a short distance (about 200 yards), while the effect, for purposes of testing recoil, &c., is practically the same as that obtained with the service projectile. They will therefore be issued for use in time of peace, where the use of the service projectile would be dangerous or inconvenient.

There will, no doubt, be emplacements from which, owing to the close vicinity of houses, it may be undesirable to use these shot in the normal line of fire. In these cases it will be often found possible, owing to the very short range of the paper shot, to find sufficient space to the right or left of the regular range to carry out such test practice as may be required.

See also footnote *.

DRILL SHELL.

This is of cast-iron, fitted with two copper bands to prevent injury to the rifling in loading and unloading. The nose is bushed with gunmetal, and the base is fitted with a large hollowed and flanged nut of gunmetal; a gunmetal ring is fitted round the base by being screwed on, a groove is formed between it and the metal of the shell to take a rope grummet, which prevents the shell being rammed too far home. It is weighted up with sand to an average weight of 380 lb. The shell can be extracted from the gun by hooking the shell extractor on the cross bar of base plug.

* Mark I shot should not be used unless the range is clear for 1,000 yards; but the other Marks may be used with a range clear up to 400 yards.

When using these shot the gun should be run up carefully and slowly.

AUGMENTING STRIPS.

DESCRIPTION.

Augmenting strips are intended to be used with B.L. projectiles in cases when the rifling of the gun has, owing to firing, become so worn, that the gun ceases to properly rotate its projectiles. The strips are of copper, of even section throughout and grooved on one side. The lengths of the strips vary with the calibre, and they are marked for the nature of the gun with which they are intended to be used.

Method of Insertion.

The top cannellure in the driving band is to be undercut all round on both sides by means of a special chisel, supplied for the purpose. The augmenting strip is then inserted in the cannellure, grooved side of strip inwards, and lightly hammered until the two tongues of metal, formed by the groove on the inner side of the strip, are dovetailed into the undercuts in the cannellure, which will in future be undercut during manufacture, and stamped U, and no preparation for the insertion of augmenting strips will be necessary.

If the gun is very much worn and one strip is found insufficient to impart the proper rotation, a second may be inserted in the lower cannellure in addition.

The number of rounds which may be fired from the 9·2-inch B.L. gun before augmenting strips must be used is (probably) 213 in the case of the Mark I gun, and 196 in the case of the later Marks.

As regards wear of the bore, reduced charges may be reckoned to have a quarter the effect of full charges.

NOTE.—They are not to be fitted to driving bands with gas check.

EXTRACTORS, DRILL SHELL, Nos. 2 AND 3.

These are of steel, with wood staves (the outer ends being grooved to prevent the bands slipping), the steel portion of each is formed to hook on the cross bar of drill shell base plug.

No. 2: This is of 8 feet total length, for all the marks of gun, except Mark IX on Mark III barbette carriage.

No. 3: This is of 13 feet 4 inches total length, for Mark IX gun on Mark III barbette carriage.

FIXING PLUGS AND FUZES, SECURING SHELLS; DISTINGUISHING MARKS, &c.

See "*Regulations for Magazines and the Preservation of Artillery Materiel.*"

FUZES.

(Plates XLIV to XLVII.)

Percussion { Base, large, No. 11.
 Direct- { with plug, No. 3, Mark III.
 Action { impact, No. 13, Marks I, I*, III.
 Time { Sensitive, middle, No. 24, Mark I.
 and percussion, middle, No. 54.
 *Drill, percussion, base, large, No. 11.

PERCUSSION, BASE, LARGE, NO. 11.

This fuze is for use in cast steel common shell, having pointed heads.

Mark II consists of the following parts, viz.:—Body, needle, pellet, centrifugal bolt, pressure plate with spindle and nut, screwed cap with detonator and plug, phosphor bronze spring, brass spring, lead washer, and four brass screws.

The body of the fuze is of manganese bronze, screwed outside (left hand), to fit the shell. The pressure plate is of copper, and is spun into the base of the fuze; it carries a spindle which retains the centrifugal bolt in the needle pellet by engaging in a slot in the latter until the pressure plate is blown in. The base of the body is recessed to admit of the pressure plate being forced in by the gas pressure when the gun is fired.

The needle pellet is of gunmetal, and has a screwed recess on top for the needle plug, and a hole bored in it, at right angles to the axis, to take the centrifugal bolt, the head of which engages into a recess in the side of the body, and is kept in that position by a spiral brass spring in the opposite side, and by the spindle of the pressure plate. The needle pellet is prevented from working forward in flight by a spiral spring of phosphor bronze.

The detonator is spun into a recess in the screwed cap, and communicates by six fire holes with the magazine containing a compressed pellet of R.F.G.² powder, between the cap and the plug.

Action.—On discharge, the pressure of the gas crushes in the pressure plate, causing the spindle to release the centrifugal bolt, the rotation of the shell causes the centrifugal bolt to be spun out, compressing the spring in rear, and leaving the needle pellet free to move forward on impact; when the needle strikes the detonator, the flash ignites the powder pellet in the magazine, and explodes the shell.

The head is painted red.

Mark I differs from Mark II:—(a) in having the shoulder under the pressure plate stouter, and consequently offering greater resistance to the plate, thus not ensuring action with reduced charges from guns on H.A. mountings; (b) the magazine contains loose M.G.¹ powder. The dimensions slightly differ also.

Weight 2 lb. 8 oz.

NOTE.—Shells fitted with this fuze must never be placed point to base.

* Service fuzes which have been burnt out will, as far as possible, be utilized for this purpose, by being cleaned and refitted with empty screwed cap and plug, bronzed, and stamped "DRILL."

DIRECT ACTION, WITH PLUG, No. 3, MARK III.

The Mark III fuze consists of the following parts, viz.:—Body, safety plug, screw collar, needle disc and steel needle, screw plug for needle disc, and bottom screw plug.

It is made of an alloy resembling gunmetal, with the exception of the steel needle, copper disc, and a few minor portions.

The *body* is threaded throughout on the exterior to the general service taper and pitch, and can be screwed into the shell to admit the naval wad being placed over it. The lower part is hollowed out to receive a blowing charge of 75 grains pistol or R.F.G. powder. The upper portion of the body is bored out to receive the safety plug, screw plug for needle disc, and screw collar; there is a recess below these to receive the detonating composition, consisting of $3\frac{1}{2}$ grains of cap composition, varnished, and covered with a disc of varnished paper, having on the top a copper washer kept in position by being spun over; this washer has a central hole, which was formerly $\cdot 2$ inch diameter, but from the 192nd thousand it is $\cdot 3$ inch diameter. At the bottom of this recess there are nine conical fire holes, to allow the flash of the detonating composition to pass to the powder; these holes are filled with mealed powder paste, and covered on the underside by a disc of fine white paper, and on the upper side by a tin foil disc (subsequent to 27th June, 1894), to prevent the detonating composition working through the powder.

The top is closed by the *safety plug*.

The *screw plug for needle disc* is tapped so as to screw into the body, recessed, and treated with cement. It is slightly coned at the bottom, and has a hole through the centre. Two holes are drilled in the top for the key in screwing the plug into the fuze.

The *needle disc* is of copper, with the steel needle in the centre; it rests on the screw plug for needle disc. The surfaces are painted with cement.

The *needle* is of steel, and of the shape shown in the section, having four points. It is sprung into the needle disc, and the edge is soldered to the latter.

The *screw collar* screws into the body over the screw plug, having two slots cut in its upper edges for that purpose. The screws are treated with cement.

The *bottom plug* has a central hole, closed on the upper side by a disc of paper, and one of shallow, and two keyholes for screwing it in. It is secured and rendered damp-proof by cement and solder.

The latest manufacture is made waterproof as much as possible, by having all openings in the body finally painted with Pettman cement.

It is prepared by simply removing the safety plug, with the flat end of the "fuze key, universal"; an arrow on the plug shows the way it is to be turned.

Action.—The fuze is at rest in all its parts till direct impact takes place, or a graze at such an angle that the nose of the shell enters the ground. When either of these events occurs, the needle is crushed down on to the detonating composition, which fires, and ignites the mealed powder in the conical holes and the fine-grain powder. The flash therefrom blows down into the shell and fires the charge.

The head of the needle being some distance below the head of the fuze, it cannot be touched or forced down on the detonating composition when any ordinary rammer is used for loading.

Weight of fuze, 5 oz. 7 drams.

DIRECT ACTION, IMPACT, No. 13.

Mark I: this is a nose fuze for the lyddite shell; the body is of gunmetal, 2.2 ins. long, screwed on the outside to G.S. gauge, the upper part being turned and furnished with a small projection on each side to receive a cap; the latter was formerly of steel, but now it is made of manganese bronze, with safety pin; the rim of the cap has a T-shaped cut on each side to lock on to the projections on the body, and there is a square keyhole in the top for fixing the fuze in the shell.

The fuze is made waterproof as much as possible, by having a disc of foolscap paper cemented on over the head, which is, with all openings made in the body, painted over with Pettman cement.

On the fuze passing through the R.L. it will be altered to agree as nearly as possible with Mark III, and will then be designated Mark I* and so stamped.

Mark III: this mark differs from Mark I in having additional arrangements in the head, with a view to the exclusion of damp.

Weight of fuze, 10 ozs.; weight of cap, 3 ozs.

SENSITIVE, MIDDLE, No. 24, MARK I.

The fuze consists of the following parts:—

Body, with stem, threaded on the lower part of the outside to G.S. gauge, and containing a blowing charge of M.G.¹ powder, and axial magazine R.F.G.² powder; composition ring, with fuze composition having leather and paper washers under it; steel needle; lighting pellet, with detonating composition in cap; two retaining pellets, with spiral springs; dome and nut; two copper safety pins, and bottom plug.

All the metal parts are of gunmetal.

A leather washer is fitted under the shoulder of the fuze closing the joint between the fuze and shell.

The composition ring is graduated on its periphery from 0 to 30, and reads to quarter units. An Ψ is stamped on the ring to show the safety point, and when this coincides with the Λ on the body, the fuze is set at safety. The cap which screws on to the top of the pillar is made hexagonal, to fit the "key, fuze, universal."

The fuze is set, after being fixed in the shell, by loosening the screw cap on the top of the stem, by means of the "key, fuze, universal," and turning the dome and ring till the required graduation on the collar coincides with the arrow head on the body, and then tightening the screw cap. The safety pins are withdrawn at the moment of loading.

Action.—On discharge, the centrifugal action causes the remaining pellets to fly out, releasing the lighting pellet, which flies out by centrifugal force, against the needle, firing the detonator which ignites the powder in the pellet and axial magazine, this latter lighting the quick match in the composition ring.

Time of burning at rest, 14.6 to 15.8 seconds.

Weight, 1 lb. 4 oz.

NOTE.—When the stock shall have been used up, Middle No. 54 fuze will be used.

TIME AND PERCUSSION, MIDDLE, No. 54.

The body of Mark III is hollow, with a stem on the upper side. Round the base of the stem an annular groove is cut, from which a

hole is bored to the side of the body for the gas to escape. The sides of the body are pierced with three fire holes; the top of the body is screwed to receive an hexagonal cap. The cap fits the hexagonal hole in the centre of the "key, fuze, universal." Between the cap and the dome fits a brass washer with feathers fitting into slots on the stem of the body; it is to prevent the dome from turning with the nut and altering the setting of the fuze when the cap is screwed tight.

The composition ring has an annular groove round it for the composition, a projection on the upper side contains the hammer with steel needle, suspended by a 0.022-inch wire, and a detonator, under it for lighting the composition in the ring. The hammer is also secured by a safety pin passing under it, the hole in the ring left by its withdrawal being closed by a brass pellet with a spiral spring above it.

The composition ring is barrel-shaped outside to facilitate the setting of the fuze. The ring is kept in position by three projections on the side, which fit closely round the stem of the body. Two escape holes are at the top of the ring at the commencement of the composition, and three radial ones are bored through the inner side at equal distances round it.

The top and first radial holes are covered with paper, the two other radial holes with asbestos. The ring is graduated from 0 to 30, and reads quarter units; the time of burning of the fuze at rest is about 16 seconds; the divisions have four sub-divisions; there is an arrow-head between the last graduation and the commencement, to show the position of safety.

To set the time arrangement of the fuze, the nut is loosened with the "key, fuze, universal," and the ring moved round till the required graduation is opposite the arrow on the body (a black triangular setting mark is now, in manufacture, substituted for the arrow on the body of the fuze); the nut is then tightened, great care being taken to see that it is screwed down as tightly as possible.

The action of the time arrangement is that, on discharge, the hammer sets back, shearing the suspending wire, and fires the detonator, which lights the end of the ring of composition; this burns until the channel communicating with the lower part of the fuze is reached, when the flash passes down it and fires the detonator and magazine in the percussion arrangement.

Mark II differs from Mark III in the latter having a percussion arrangement similar to that in the "time and percussion, fuze, No. 56, Mark IV"; the time ring having no escape holes, except the two at the commencement of the fuze composition; the loops of the eyes of the safety pins are stronger in Mark III, and the time pin is now fitted with a scarlet cord loop.

Mark I has been altered to agree with Mark II, and is now Mark I*. In future conversion, the fuzes will be fitted with solid wire time safety pins.

Weight 1 lb. 4 oz.

TUBES.

(Plates XLVIII to L.)

Tubes, vent-sealing	{	Electric,	{	P., Mark VII.
		{	P., drill,* Mark III.	
			wireless, P., Mark II.	
		Percussion,	Mark VI.	
		Percussion, drill,	Mark I.	
Primer vent, cordite, Mark I.				

The percussion lock arrangement necessitates a special tube for firing the charge, and this tube performs a double duty in sealing the vent when fired so as to prevent the escape of gas. The tubes, both for service and drill, are made of two patterns for firing by hand or by electricity.

TUBE, VENT-SEALING, ELECTRIC, P.

Mark VII is made of brass bored out to receive the arrangement for firing by electricity. The interior of the body near the head is conical, a hole is drilled in the head through which pass two tinned copper wires twisted together and insulated by varnished silk, on the interior the wires are parted, and led through a V-shaped groove across the head, they are then twisted together again and wrapped with oiled silk for a length of 5 inches, and terminate in spirals. 22 inches from the tube, the spirals are covered with sarcenet. In the interior near the head are two cones, the larger one fitting into the recess in the body, the small one fitting into a conical recess in the large cone, they are insulated from each other and from the body by ebonite; the front end of one of the wires is attached to the rear end of the large cone, and the end of the other wire passes through the large cone; insulated from it, and is attached to the rear end of the small cone. A copper pole is fastened to the front end of each of the cones, the poles being connected by a platinum silver wire bridge, embedded in priming composition. The remainder of the tube is filled with pistol powder (in present manufacture pellet powder is used), the end is closed with a varnished cork and shellaced paper disc, and in latest manufacture a paper disc is placed over the cork plug, to prevent it sticking to the cork bottom of the tube box.

Action.—The wires from the battery are connected to the wires of the tube and on a current of electricity being passed through them, the bridge becomes incandescent and fires the tube. The cones are jammed into each other and the coned part of the body, and prevent any escape of gas through the head.

Mark VI is identical in construction with Mark VII, but the wires are led through a groove across the head instead of the V-shaped groove, and it is without the extra 5 inches of oiled silk wrapping on the wires.

Mark V is similar in construction to Mark VI, but the end is closed with a sulphur pellet in which is embedded a brass ball. *It must not be used unless the range is clear.*

Mark IV; the wires were laid in two slots in the head, and passed through by separate holes, then through an asbestos plug and small air space, and soldered to two brass poles embedded in a conical ebonite plug. The same precaution is to be taken as with Mark V.

* When worn out service tubes will be used instead.

Mark III; the cylindrical portion of the body was entirely filled with powder, there was no brass ball, the end being closed by a cork and paper disc, and the wires 1 inch shorter than in IV.

Mark II was of solid drawn brass in construction similar to III, but the wires were only 18 inches long.

Mark I was similar to II, but the wires were not tinned over, and the bridge was attached to the poles with ordinary solder.

Packed 5 in a tin box.

TUBE, VENT-SEALING, ELECTRIC, WIRELESS, P. (FOR MARKS IX, X, AND XV GUNS).

Mark I consists of a body, conical brass plug, copper pole, cork plug, ebonite cup, ebonite plug, hollow ebonite cone, insulated copper wire, two paper discs, and two platinum-silver wires.

The body is made of brass, with a recess in the head to receive an ebonite cup which (since 1st February, 1899) is screwed into the head of the tube, and into which fits a white-metal contact piece, secured by an undercut groove in the ebonite, and connected by an insulated copper wire with the interior of the tube; a hole is bored through the head of the tube for the copper wire to pass through. The lower end of the insulated wire is attached to the brass conical plug, which is insulated from the body of the tube by the hollow ebonite cone. The large end of the brass plug is cupped-out to form a gas-check, and has a centre hole bored and screwed to receive an ebonite plug. Into this ebonite plug is fixed the copper pole, which consists of a copper wire, coated with pure tin, one end fitting into the ebonite plug, the other being secured to the side of the tube.

The copper pole and conical brass plug are connected by a double bridge of platinum-silver wire. The space round the bridge and pole is charged with 2 grains of composition priming, over which is placed a white paper disc.

The tube is filled with about 24 grains of pistol powder (in present manufacture a special fine grained powder is used), and the end is closed by a disc of white paper and a cork plug shellaced in.

Action.—On contact being made the current passes through the striker, short wire, cone, double bridge, long copper pole, and the body of the tube. The double bridge becomes incandescent, which fires the priming and powder, the gas expands the cupped-out plug and prevents the escape of gas through the head, the current passing back to the battery again through the metal of the tube and gun.

Mark II differs from Mark I in having a single instead of a double bridge, and in a few slight manufacturing details; the conical plug is somewhat larger in diameter, the contact disc is of pure tin in present manufacture, instead of white-metal as previously; tubes having the pure tin contact disc will be distinguished by the letter "T" stamped on the head; two paper discs are used in closing the tube, one on either side of the cork plug.

The tubes are packed 10 in a tin box.

TUBE, VENT-SEALING, PERCUSSION.

Mark VI tube differs from Mark V in the form of striker, which has a plain flange at the base of the needle portion, and is fitted with a cup-shaped gascheck. It is filled with R.F.G.² powder siftings, but in future a special fine grain powder will be used.

Mark V tube consists of a body, striker, screwed collar, detonator,

two washers, shearing wire, two paper discs, and cork plug. The body is of solid drawn brass, the head is bored centrally for the striker, detonator, and fire channel. The striker has a needle point, and is held by a copper shearing wire; the detonator is held underneath the striker by a brass screwed collar, which is retained in position by a copper washer at its base. A disc of fine white paper is placed over the copper washer. The tube is filled with R.L.G.² powder, the interstices being filled up R.F.G.² powder, but in latest manufacture a special fine grain powder (those filled on or before 14th December, 1899, were filled with pistol powder); it is closed with a paper disc, and cork plug coated with varnish.

Action.—On firing the gun the point of the striker of the percussion lock drives the striker of the tube on to the detonator, thus firing the tube, the flash passing on to the charge.

Mark IV consists of a body, anvil, striker, washer, percussion cap, copper disc, two paper discs, and a cork plug. The body is of solid drawn brass; a hole is drilled through the head to receive the striker which is secured in position by being rivetted into the countersunk washer, as shown in the plate. The upper part of the chamber is screwed and fitted with an anvil, on which is placed a percussion cap, the upper surface of which is in contact with the striker; a small central and two diagonal fire holes are drilled through the anvil. The remainder of the space in the tube is filled with loose pistol powder, and the bottom is closed with a paper disc and cork plug, coated with varnish.

Action.—This is the same as the Mark V tube, excepting that the striker of the tube, together with the percussion cap, are driven on to the anvil, thus firing the tube.

Mark III differs from Mark IV in that the bottom of the tube is closed with a paper disc and perforated brass ball, embedded in sulphur and secured with shellac. *It must not be used unless the range is clear.*

Mark II has not the diagonal fire holes in the anvil as in IV, but a central fire-hole. There is no brass ball.

Mark I is obsolete.

Packed 10 in a tin box.

TUBE, VENT-SEALING, ELECTRIC, P, DRILL.*

Mark III is of gunmetal in three parts, screwed together, and milled outside. Two insulated copper wire terminals pass through a slot in the head and are continued at right angles into the interior to form the poles, the holes bored for their reception in the head are lined with ebonite.

The slot in the head is covered with a small brass plate which affords the wires protection from friction against the percussion lock. The poles are connected by a platinum silver bridge. Through the head are also two escape holes for the flash of the priming. The wires are whipped together near the head with black thread, and terminate in spirals 22 inches from the tube. The tube is issued empty. When required for use it will be charged with a small quantity of priming composition, the escape holes being lightly stopped with luting on the outside.

Mark II is similar to Mark III, but has the wire terminals only 18 inches long.

* When stock is worn out service tubes will be used instead.

Mark I has wires terminating in brass spring sockets instead of spirals, and the wires in the groove in the head are not protected by the brass plate.

TUBE, VENT-SEALING, PERCUSSION, DRILL.

This tube is made of gunmetal, the interior being bored out and the head fitted to receive the coned indiarubber plug as shown in the plate. The lower portion is closed by a gunmetal plug.

PRIMER, VENT, CORDITE, MARK I.

This consists of a stick of cordite, size 20, cut 4.75 inches long. It is for use with powder charges and vent-sealing tubes without ball, and is put in the vent after the breech is closed and before the tube is inserted.

Packed 10 in a box.

ORDNANCE, B.L., LEVER, EXTRACTOR.

This consists of a steel rod, about 9 inches in length, having toe pieces at either end, which may be inserted in the loop of the extractor to which the lanyard is attached, the sides of the lock frame affording a fulcrum. It is intended for prising up the extractor of the lock in the event of it failing to withdraw the tube when the lanyard is pulled.

NOTES.

In the event of a tube failing to ignite a charge care should be taken in extracting the fired tube not to stand directly in rear of the gun, as the gas generated will cause the tube to fly out with some violence when eased by the extractor.

The vent sometimes becomes choked with residue from the cartridge. It should be cleared with a "Rimer, vent, axial" sufficiently to allow of the insertion of a tube, which, when fired, will remove the rest of the obstruction.

Care must be taken to see that the range is clear when using Marks IV and V Electric, or Mark III Percussion tubes, for any other purpose than regular practice (in which case the range would, of course, be clear before firing), as the brass ball is projected with considerable velocity by the powder in the tube.

A tube is not to be inserted in the vent till the breech is properly closed.

RANGE TABLE for 9.2-inch B.L. Gun, Marks I and II (full charge),

Based on Practice and Calculation.

Minutes 8,378, 13,555, and 44,500 V.

Charge, { weight, 140 lb.; prism¹, brown.
gravimetric density, 30.7
weight, 42 lb. cordite, size 30.
gravimetric density, 102.4
Projectile, weight, 380 lb.

Muzzle velocity, 1,781 f.s.
Jump + 4 minutes.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact			ELEVATION.	RANGE.	Scale for time and percussion middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.					Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ' "	yards.			yards.	yards.	yards.	seconds.	inches.
1765	1145	687	101	0.14	0 1	100	1	20	0.05	...	...	0.16	17.5
1749	572	343	99	0.29	0 6	200	1	20	0.05	...	...	0.32	17.3
1734	383	229	98	0.43	0 11	300	11	20	0.1	0.1	0.1	0.49	17.2
1719	273	164	96	0.58	0 16	400	1	20	0.1	0.1	0.1	0.66	17.3
1704	229	131	95	0.72	0 21	500	2	20	0.15	0.1	0.1	0.83	16.8
1689	178	107	94	0.87	0 27	600	2	20	0.15	0.2	0.2	1.00	16.7
1674	157	90	93	1.01	0 32	700	3	20	0.2	0.2	0.2	1.18	16.5
1659	130	78	92	1.16	0 38	800	3	20	0.2	0.2	0.2	1.36	16.3
1644	115	69	91	1.21	0 43	900	4	20	0.25	0.3	0.3	1.53	16.1
1629	102	61	90	1.45	0 49	1000	4	20	0.3	0.3	0.3	1.71	16.0
1614	92	55	89	1.60	0 55	1100	5	20	0.3	0.3	0.3	1.89	15.9
1599	83	50	88	1.74	1 0	1200	5	20	0.35	0.4	0.4	2.07	15.7
1585	77	46	87	1.89	1 6	1300	5	20	0.4	0.4	0.4	2.25	15.6
1570	70	42	86	2.03	1 12	1400	6	20	0.4	0.4	0.4	2.44	15.4
1556	65	39	85	2.18	1 18	1500	6	20	0.45	0.5	0.5	2.63	15.3
1542	60	36	84	2.32	1 24	1600	7	20	0.45	0.5	0.5	2.82	15.1
1528	55	33	83	2.47	1 30	1700	7	20	0.5	0.5	0.5	3.01	15.0
1514	52	31	82	2.61	1 36	1800	8	20	0.55	0.6	0.6	3.20	14.8
1501	50	30	81	2.76	1 42	1900	8	20	0.55	0.6	0.6	3.39	14.7
1488	47	28	80	2.91	1 48	2000	9	20	0.6	0.6	0.6	3.59	14.6
1475	43	26	79	3.05	1 54	2100	9	20	0.65	0.7	0.7	3.79	14.4
1462	40	24	78	3.20	2 0	2200	10	20	0.7	0.7	0.7	3.99	14.3
1449	38	23	77	3.34	2 6	2300	10	20	0.75	0.8	0.8	4.19	14.1
1436	37	22	76	3.49	2 12	2400	11	20	0.8	0.8	0.8	4.39	14.0
1423	35	21	75	3.63	2 19	2500	11	20	0.8	0.9	0.9	4.60	13.9
1410	33	21	74	3.78	2 25	2600	12	20	0.85	1.0	1.0	4.81	13.7
1397	32	20	73	3.92	2 32	2700	12	20	0.9	1.0	1.0	5.02	13.6
1384	30	19	72	4.07	2 39	2800	13	21	0.95	1.1	1.1	5.23	13.4
1371	29	18	71	4.21	2 46	2900	13	21	1.0	1.2	1.2	5.44	13.3
1359	28	17	71	4.36	2 53	3000	14	21	1.1	1.3	1.3	5.65	13.2
1347	27	17	70	4.51	3 0	3100	14	21	1.1	1.4	1.4	5.86	13.1
1335	26	16	69	4.65	3 7	3200	15	21	1.1	1.5	1.5	6.08	12.9
1324	25	16	68	4.80	3 14	3300	16	22	1.2	1.6	1.6	6.30	12.8
1313	24	15	67	4.94	3 22	3400	16	22	1.2	1.7	1.7	6.52	12.7
1302	23	14	67	5.09	3 29	3500	17	22	1.3	1.8	1.8	6.75	12.6
1291	22	13	66	5.23	3 36	3600	17	23	1.3	1.9	1.9	6.97	12.5
1280	21	13	65	5.38	3 44	3700	18	23	1.4	2.0	2.0	7.20	12.3
1269	20	12	64	5.52	3 51	3800	19	24	1.4	2.1	2.1	7.43	12.2
1258	19	12	63	5.67	3 59	3900	19	24	1.5	2.2	2.2	7.66	12.1
1247	18	11	63	5.81	4 7	4000	20	24	1.5	2.3	2.3	7.89	11.9
1237	17	10	62	5.96	4 15	4100	20	24	1.6	2.4	2.4	8.12	11.8
1227	17	10	61	6.11	4 23	4200	21	25	1.7	2.5	2.5	8.36	11.7
1217	16	9	61	6.25	4 31	4300	22	25	1.7	2.6	2.6	8.60	11.6
1207	15	9	60	6.40	4 39	4400	22	25	1.8	2.7	2.7	8.84	11.5
1198	15	9	59	6.54	4 48	4500	23	26	1.9	2.9	2.9	9.09	11.4

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.			ELEVATION.	Range.	Fuze scale for time and percussion middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.					Length.	Breadth.	Height.		
f.s.	yards.	lin	yards.	yards.	° ' "	yards.			yards.	yards.	yards.	seconds.	inches.
1188	14	9	59	6.69	4 56	4600	23 1/2	26	1.9	3.1	3.1	9.32	11.3
1179	14	8	58	6.83	5 5	4700	24 1/2	26	2.0	3.2	3.2	9.56	11.2
1170	13	8	57	6.98	5 14	4800	25 1/2	27	2.1	3.4	3.4	9.80	11.1
1161	13	8	57	7.13	5 23	4900	26 1/2	27	2.2	3.5	3.5	10.05	11.0
1152	13	7	56	7.27	5 32	5000	27 1/2	27	2.2	3.7	3.7	10.30	10.9
1143	12	7	55	7.42	5 41	5100	27 1/2	27	2.3	3.9	3.9	10.55	10.8
1135	12	7	55	7.56	5 50	5200	27 1/2	28	2.4	4.0	4.0	10.80	10.8
1127	12	7	54	7.71	6 0	5300	28 1/2	28	2.5	4.2	4.2	11.06	10.7
1119	11	7	53	7.85	6 9	5400	29 1/2	28	2.5	4.3	4.3	11.33	10.6
1111	11	6	53	8.00	6 19	5500	29 1/2	28	2.6	4.5	4.5	11.60	10.5
1103	11	6	52	8.14	6 29	5600	...	29	2.7	4.6	4.6	11.87	10.4
1095	10	6	51	8.29	6 39	5700	...	29	2.8	4.7	4.7	12.15	10.3
1088	10	6	51	8.43	6 49	5800	...	29	2.9	4.8	4.8	12.42	10.3
1081	10	6	50	8.58	6 59	5900	...	29	3.0	5.0	5.0	12.68	10.2
1074	10	6	50	8.73	7 9	6000	...	30	3.1	5.2	5.2	12.95	10.1
1067	9	5	49	8.87	7 20	6100	...	30	3.1	5.5	5.5	13.2	10.0
1060	9	5	49	9.01	7 31	6200	...	31	3.2	5.8	5.8	13.5	10.0
1051	9	5	48	9.16	7 42	6300	...	31	3.3	6.2	6.2	13.8	9.9
1048	8	5	48	9.30	7 53	6400	...	32	3.3	6.6	6.6	14.1	9.8
1042	8	5	47	9.45	8 4	6500	...	33	3.4	7.0	7.0	14.3	9.8
1037	8	5	47	9.60	8 15	6600	...	33	3.5	7.3	7.3	14.6	9.7
1032	8	5	46	9.74	8 26	6700	...	31	3.5	7.6	7.6	14.9	9.7
1027	7	4	46	9.89	8 37	6800	...	35	3.6	7.9	7.9	15.2	9.6
1022	7	4	45	10.03	8 48	6900	...	36	3.6	8.3	8.3	15.4	9.6
1017	7	4	45	10.18	8 59	7000	...	37	3.7	8.7	8.7	15.7	9.5
1013	7	4	44	10.32	9 11	7100	...	37	3.8	9.0	9.0	16.0	9.5
1008	6	4	41	10.46	9 22	7200	...	38	3.8	9.4	9.4	16.3	9.4
1004	6	4	43	10.60	9 34	7300	...	39	3.9	9.8	9.8	16.6	9.4
999	6	4	43	10.75	9 46	7400	...	40	3.9	10	10	16.9	9.3
995	6	4	42	10.89	9 58	7500	...	41	4.0	10	10	17.2	9.3
991	6	4	42	11.04	10 10	7600	...	41	4.1	10	10	17.5	9.2
987	6	4	42	11.19	10 22	7700	...	42	4.1	10	10	17.8	9.2
983	5	3	41	11.34	10 34	7800	...	43	4.2	11	11	18.1	9.1
978	5	3	41	11.48	10 46	7900	...	44	4.2	11	11	18.4	9.1
974	5	3	41	11.63	10 59	8000	...	45	4.3	11	11	18.7	9.0
970	5	3	40	11.77	11 11	8100	...	45	4.4	11	11	19.0	9.0
965	5	3	40	11.92	11 24	8200	...	46	4.5	12	12	19.3	8.9
961	5	3	39	12.07	11 37	8300	...	47	4.5	12	12	19.6	8.9
957	5	3	39	12.22	11 50	8400	...	48	4.6	12	12	20.0	8.8
953	5	3	39	12.36	12 2	8500	...	49	4.7	12	12	20.3	8.8
949	5	3	38	12.51	12 15	8600	...	49	4.7	12	12	20.6	8.7
945	5	3	38	12.65	12 28	8700	...	50	4.8	13	13	20.9	8.7
941	5	3	38	12.80	12 41	8800	...	51	4.9	13	13	21.2	8.6
938	4	3	37	12.94	12 54	8900	...	52	5.0	13	13	21.5	8.6
935	4	3	37	13.09	13 7	9000	...	53	5.1	13	13	21.9	8.6
931	4	3	37	13.24	13 20	9100	...	53	5.1	13	13	22.2	8.5
928	4	2	36	13.38	13 34	9200	...	54	5.2	14	14	22.5	8.5
925	4	2	36	13.53	13 48	9300	...	55	5.3	14	14	22.8	8.4
922	4	2	36	13.67	14 2	9400	...	56	5.4	14	14	23.2	8.4
911	4	2	36	13.81	14 16	9500	...	57	5.5	14	14	23.5	8.3
916	4	2	35	13.96	14 31	9600	...	58	5.6	15	15	23.8	8.3
913	4	2	35	14.11	14 46	9700	...	59	5.6	15	15	24.1	8.3
910	3	2	35	14.26	15 1	9800	...	60	5.7	15	15	24.5	8.2
907	3	2	35	14.40	15 16	9900	...	61	5.8	15	15	24.8	8.2
904	3	2	35	14.55	15 32	10000	...	62	5.9	16	16	25.2	8.1

RANGE TABLE for 9.2-inch B.L. Guns, Marks III, IV, V, and VI.

Based on Practice of 7 and 9. 7. 84.

Minute 6,624.

Charge { weight, 164 lb.
gravimetric density, 27.95
0.992
nature, prism¹, brown, or 53½ lb.
cordite, size 30.

Muzzle velocity, 2065 f.s.

Nature of mounting, Whitworth temporary

Jump, nil.

Projectile, weight, 380 lb.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.				50 per cent. of rounds should fall in				Time of flight.	Penetration into wrought iron (into compound armour, it is $\frac{1}{16}$ of the penetration into W.I.).
f.s.	yards.	1 in	Range.	Laterally or vertically.	ELEVATION.	RANGE.	FEET scale for middle sensitive time fuze.	Length.	Breadth.	Height.	seconds.	inches.
2016	1432	859	...	0.14	0 4	100	0	23	0.05	0.1	0.14	20.5
2028	716	429	...	0.29	0 8	200	0½	20	0.05	0.1	0.29	20.3
2010	477	286	...	0.43	0 12	300	1½	20	0.1	0.1	0.44	20.1
1992	356	215	...	0.58	0 16	400	1¾	20	0.1	0.1	0.59	19.9
1974	273	164	...	0.72	0 20	500	2½	20	0.1	0.1	0.74	19.7
1957	220	132	...	0.87	0 24	600	2¾	20	0.15	0.1	0.90	19.6
1940	185	111	...	1.0	0 29	700	3½	20	0.15	0.1	1.05	19.4
1923	164	98	...	1.16	0 33	800	3¾	20	0.2	0.2	1.21	19.2
1906	143	86	...	1.3	0 37	900	4½	19	0.2	0.2	1.27	19.0
1889	130	78	...	1.4	0 41	1000	4¾	19	0.25	0.2	1.53	18.8
1872	117	70	112	1.5	0 46	1100	5½	19	0.25	0.2	1.69	18.7
1856	106	64	111	1.6	0 50	1200	5¾	19	0.3	0.3	1.86	18.5
1840	97	58	110	1.8	0 54	1300	6½	19	0.3	0.3	2.02	18.3
1824	90	54	103	1.9	0 59	1400	6¾	19	0.35	0.3	2.19	18.2
1808	83	50	107	2.1	1 3	1500	7½	19	0.35	0.3	2.35	18.0
1792	77	46	105	2.2	1 8	1600	7¾	19	0.4	0.4	2.52	17.8
1777	72	43	105	2.4	1 12	1700	8½	19	0.4	0.4	2.68	17.6
1762	67	40	104	2.5	1 17	1800	8¾	19	0.45	0.4	2.85	17.5
1747	62	37	103	2.7	1 22	1900	9½	19	0.45	0.5	3.02	17.3
1732	58	35	102	2.9	1 27	2000	9¾	19	0.5	0.5	3.20	17.2
1717	55	33	101	3.0	1 32	2100	10½	19	0.55	0.5	3.38	17.0
1702	52	31	99	3.2	1 37	2200	10¾	19	0.55	0.6	3.56	16.8
1687	49	29	98	3.3	1 43	2300	11½	19	0.6	0.6	3.74	16.7
1672	46	27	96	3.5	1 48	2400	12½	19	0.65	0.6	3.92	16.5
1658	43	26	95	3.7	1 53	2500	12¾	19	0.65	0.7	4.10	16.3
1643	41	25	93	3.8	1 59	2600	13½	19	0.7	0.7	4.28	16.2
1628	39	23	92	4.0	2 4	2700	13¾	19	0.75	0.7	4.46	16.0
1614	37	22	90	4.1	2 10	2800	14½	19	0.8	0.8	4.65	15.9
1599	35	21	89	4.2	2 16	2900	14¾	19	0.8	0.8	4.84	15.7
1585	33	20	88	4.3	2 22	3000	15½	19	0.85	0.8	5.03	15.6
1571	32	19	87	4.5	2 27	3100	15¾	19	0.9	0.8	5.22	15.4
1556	31	18	86	4.6	2 33	3200	16½	19	0.95	0.9	5.41	15.3
1542	29	18	85	4.8	2 39	3300	17½	19	0.95	1.0	5.61	15.1
1528	28	17	83	4.9	2 45	3400	17¾	19	1.0	1.0	5.81	15.0
1515	27	16	82	5.1	2 51	3500	18½	19	1.0	1.1	6.01	14.8
1502	26	15	81	5.2	2 57	3600	19	19	1.1	1.2	6.21	14.7
1489	25	15	80	5.4	3 3	3700	19½	19	1.1	1.2	6.41	14.6
1476	24	14	79	5.5	3 9	3800	20½	20	1.2	1.3	6.62	14.4
1463	23	14	78	5.7	3 15	3900	20¾	20	1.2	1.4	6.83	14.3
1450	22	13	77	5.8	3 21	4000	21½	20	1.3	1.5	7.04	14.1
1437	21	13	76	6.0	3 28	4100	22½	20	1.3	1.6	7.25	14.0
1424	20	12	75	6.1	3 34	4200	22¾	21	1.4	1.7	7.46	13.9
1411	20	12	74	6.3	3 41	4300	23½	21	1.4	1.8	7.67	13.7
1398	19	11	73	6.4	3 47	4400	24½	21	1.5	1.9	7.88	13.6
1386	18	11	72	6.6	3 54	4500	24¾	22	1.6	2.0	8.10	13.4

RANGE TABLE for 9.2-in. B.L. Guns, Marks III, IV, V, and VI—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	Range.	Fuze scale for middle sensitive time fuze.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron (into compound armour, it is $\frac{1}{10}$ of the penetration into W.I.).
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	inches.
1374	18	11	71	6.7	4 1	4600	23	22	1.6	2.1	8.31	13.3
1362	17	10	70	6.8	4 7	4700	21	23	1.7	2.2	8.31	13.3
1350	17	9.9	69	7.0	4 14	4800	20	23	1.8	2.3	8.31	13.3
1338	16	9.6	68	7.1	4 21	4900	27	24	1.8	2.4	8.39	12.9
1327	16	9.3	67	7.2	4 28	5000	28	24	1.9	2.6	9.22	12.8
1316	15	9.0	67	7.4	4 36	5100	29	25	1.9	2.7	9.45	12.7
1305	15	8.7	66	7.5	4 43	5200	29	25	2.0	2.9	9.63	12.6
1294	14	8.5	65	7.7	4 50	5300	29	26	2.1	3.0	9.91	12.5
1283	14	8.2	65	7.8	4 58	5400	29	26	2.1	3.2	10.15	12.3
1272	13	8.0	64	8.0	5 6	5500	29	26	2.2	3.3	10.4	12.2
1261	13	7.8	63	8.1	5 13	5600	29	27	2.3	3.5	10.6	12.1
1250	13	7.5	62	8.3	5 21	5700	29	27	2.3	3.6	10.85	11.9
1239	12	7.3	62	8.4	5 29	5800	29	28	2.4	3.8	11.1	11.8
1229	12	7.1	61	8.6	5 37	5900	29	28	2.5	3.9	11.35	11.7
1219	11	6.9	60	8.7	5 45	6000	29	28	2.6	4.1	11.6	11.6
1210	11	6.7	59	8.9	5 54	6100	29	29	2.7	4.3	11.85	11.5
1200	11	6.5	59	9.0	6 3	6200	29	29	2.8	4.5	12.1	11.4
1190	11	6.3	58	9.1	6 11	6300	29	29	2.9	4.7	12.3	11.3
1180	10	6.1	57	9.2	6 20	6400	29	29	3.0	4.9	12.6	11.2
1171	10	6.0	56	9.3	6 29	6500	29	29	3.1	5.1	12.8	11.1
1162	10	5.8	56	9.5	6 37	6600	29	29	3.2	5.3	13.1	11.0
1153	9	5.7	55	9.6	6 45	6700	29	29	3.3	5.5	13.3	10.9
1144	9	5.5	54	9.8	6 55	6800	29	29	3.4	5.7	13.6	10.8
1136	9	5.4	54	9.9	7 4	6900	29	29	3.5	5.9	13.9	10.8
1128	9	5.2	53	10.1	7 14	7000	29	29	3.6	6.1	14.1	10.7
1120	8	5.1	52	10.2	7 23	7100	29	29	3.7	6.3	14.4	10.6
1112	8	4.9	51	10.4	7 33	7200	29	29	3.8	6.5	14.7	10.5
1104	8	4.8	51	10.5	7 43	7300	29	29	3.9	6.7	15.0	10.4
1096	8	4.7	50	10.7	7 53	7400	29	29	4.0	6.9	15.2	10.3
1089	8	4.6	49	10.8	8 4	7500	29	29	4.1	7.1	15.5	10.3
1082	7	4.5	49	11.0	8 14	7600	29	29	4.2	7.3	15.8	10.2
1075	7	4.4	48	11.2	8 25	7700	29	29	4.3	7.5	16.1	10.1
1068	7	4.3	47	11.3	8 36	7800	29	29	4.4	7.7	16.3	10.0
1061	7	4.1	46	11.4	8 47	7900	29	29	4.5	7.9	16.6	10.0
1055	7	4.0	46	11.6	8 57	8000	29	29	4.6	8.1	16.9	9.9
1049	6	3.9	45	11.7	9 8	8100	29	29	4.7	8.3	17.2	9.8
1043	6	3.8	45	11.8	9 19	8200	29	29	4.8	8.5	17.5	9.8
1038	6	3.7	44	12.0	9 30	8300	29	29	4.9	8.7	17.8	9.7
1033	6	3.6	44	12.1	9 41	8400	29	29	5.0	8.9	18.0	9.7
1028	6	3.5	43	12.2	9 53	8500	29	29	5.1	9.1	18.3	9.6
1023	6	3.4	43	12.3	10 4	8600	29	29	5.2	9.3	18.6	9.6
1018	6	3.4	42	12.5	10 16	8700	29	29	5.3	9.5	18.9	9.5
1014	5	3.3	42	12.6	10 28	8800	29	29	5.4	9.7	19.2	9.5
1009	5	3.2	41	12.8	10 39	8900	29	29	5.5	9.9	19.5	9.4
1005	5	3.1	41	13.0	10 51	9000	29	29	5.6	10.1	19.8	9.4
1000	5	3.1	40	13.1	11 3	9100	29	29	5.7	10.3	20.1	9.3
996	5	3.0	40	13.3	11 15	9200	29	29	5.8	10.5	20.4	9.3
992	5	2.9	40	13.4	11 27	9300	29	29	5.9	10.7	20.7	9.2
988	5	2.9	39	13.6	11 39	9400	29	29	6.0	10.9	21.0	9.2
984	5	2.8	39	13.7	11 51	9500	29	29	6.1	11.1	21.3	9.1
980	5	2.7	38	13.9	12 3	9600	29	29	6.2	11.3	21.6	9.1
976	4	2.7	38	14.0	12 16	9700	29	29	6.3	11.5	21.9	9.0
972	4	2.6	37	14.2	12 29	9800	29	29	6.4	11.7	22.2	9.0
968	4	2.6	37	14.3	12 42	9900	29	29	6.5	11.9	22.5	8.9
964	4	2.5	37	14.5	12 55	10000	29	29	6.6	12.1	22.8	8.9

FUZE SCALE for 9.2-inch B.L. Guns. Marks I to VII.

Based on practice of 21.3.97 (Minute 43161rt).

Fuze, T. and P., middle, No. 54, Marks I*, II, or III.

Projectile, Shrapnel Shell.

Charge (full), 164 lb., Prism¹ brown, or 53½ lb. Cordite, size 36.

Range.	Fuze set.	Range.	Fuze set.	Range.	Fuze set.	Range.	Fuze set.
100	½	1600	6½	3100	13	4600	21
200	¾	1700	6¾	3200	13½	4700	21½
300	1¼	1800	7¼	3300	14	4800	22
400	1½	1900	7½	3400	14½	4900	22½
500	2	2000	8	3500	15	5000	23½
600	2½	2100	8½	3600	15½	5100	23¾
700	2¾	2200	9	3700	16	5200	24½
800	3¼	2300	9¼	3800	16½	5300	25
900	3½	2400	9½	3900	17	5400	25½
1000	4	2500	10¼	4000	17½	5500	26½
1100	4¼	2600	10¾	4100	18¼	5600	27
1200	4¾	2700	11¼	4200	18¾	5700	27½
1300	5¼	2800	11¾	4300	19¼	5800	28½
1400	5½	2900	12	4400	19¾	5900	28¾
1500	6	3000	12½	4500	20¼	6000	29½

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (full charge).

Based on Practice of 11 and 13. 7. 98.

Minute 45,700.

Charge	{	weight, 100 lb.	{	Muzzle velocity, 2,601 f.s.
		gravimetric density, $\frac{81.0}{0.342}$		Nature of mounting, barbette, Mark III.
Projectile	{	nature, cordite, size 41.	{	Jump, $7\frac{1}{2}$ minutes, negative.
		nature, common shell, pointed, Mark II.		Corrected for gun on same level as target.
	{	weight, 370 lb.		

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or depression alters point of impact.		ELEVATION.	RANGE.	Fuz. scale for time and percussion middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	°	yards.		yards.	yards.	yards.	seconds.	inches.
2571	2833	1700	250	0.14	0 10	100	0	19.8	0.10	0.08	0.12	32.0
2512	950	572	166	0.29	0 13	200	0	20.0	0.14	0.09	0.24	31.5
2513	635	381	164	0.43	0 16	300	1	20.01	0.16	0.11	0.36	31.0
2485	477	286	162	0.58	0 19	400	1	20.03	0.18	0.14	0.48	30.5
2457	381	229	160	0.72	0 21	500	1	20.01	0.21	0.15	0.60	30.0
2431	317	190	158	0.87	0 23	600	1	20.05	0.25	0.16	0.72	29.5
2404	285	171	156	1.01	0 26	700	2	20.07	0.28	0.18	0.84	29.0
2376	245	147	154	1.16	0 29	800	2	20.08	0.31	0.20	0.96	28.5
2350	207	124	152	1.31	0 31	900	2	20.09	0.35	0.21	1.09	28.0
2325	178	107	150	1.45	0 34	1000	3	21.1	0.38	0.24	1.22	27.5
2300	160	96	148	1.60	0 37	1100	3	21.3	0.40	0.25	1.34	27.0
2274	145	87	146	1.74	0 40	1200	3	21.4	0.43	0.27	1.47	26.6
2250	133	80	144	1.89	0 43	1300	4	21.6	0.47	0.29	1.60	26.2
2226	122	73	143	2.03	0 46	1400	4	21.7	0.50	0.31	1.73	25.8
2203	113	68	141	2.18	0 49	1500	4	21.8	0.54	0.34	1.86	25.4
2180	106	63	139	2.32	0 52	1600	5	22.0	0.57	0.37	2.00	25.0
2157	100	60	138	2.47	0 55	1700	5	22.2	0.59	0.39	2.14	24.6
2135	93	56	137	2.61	0 58	1800	5	22.4	0.61	0.41	2.28	24.2
2115	88	53	135	2.76	1 1	1900	6	22.5	0.63	0.43	2.41	23.8
2095	83	50	133	2.91	1 4	2000	6	22.6	0.66	0.45	2.55	23.5
2075	80	48	131	3.05	1 7	2100	6	22.8	0.69	0.50	2.69	23.2
2055	77	46	129	3.20	1 11	2200	7	23.0	0.71	0.52	2.83	22.8
2036	75	45	128	3.34	1 14	2300	7	23.2	0.74	0.55	2.98	22.5
2017	72	43	127	3.49	1 17	2400	8	23.4	0.77	0.58	3.13	22.2
1998	68	41	125	3.63	1 21	2500	8	23.6	0.80	0.61	3.28	21.9
1980	65	39	124	3.78	1 25	2600	8	23.8	0.83	0.64	3.43	21.6
1963	61	37	123	3.92	1 28	2700	9	24.0	0.85	0.68	3.58	21.3
1945	60	36	122	4.07	1 31	2800	9	24.3	0.88	0.71	3.73	21.0
1928	58	35	122	4.21	1 35	2900	9	24.5	0.90	0.74	3.88	20.7
1911	55	33	121	4.36	1 38	3000	10	24.8	0.92	0.78	4.03	20.5
1896	53	32	120	4.51	1 41	3100	10	25.0	0.94	0.81	4.18	20.2
1881	50	30	119	4.65	1 45	3200	11	25.2	0.97	0.85	4.31	20.0
1865	48	29	118	4.80	1 49	3300	11	25.5	1.00	0.89	4.50	19.7
1850	47	28	117	4.94	1 53	3400	11	25.7	1.03	0.93	4.66	19.5
1835	45	27	116	5.09	1 56	3500	12	26.0	1.05	0.98	4.82	19.3
1820	43	26	115	5.23	2 0	3600	12	26.2	1.08	1.02	4.98	19.1
1805	41	25	114	5.38	2 4	3700	13	26.5	1.10	1.07	5.14	18.8
1792	40	24	113	5.52	2 8	3800	13	26.8	1.13	1.12	5.30	18.6
1778	38	23	112	5.67	2 12	3900	13	27.0	1.17	1.17	5.46	18.4
1764	37	22	111	5.81	2 16	4000	14	27.3	1.20	1.22	5.62	18.2
1750	35	21	111	5.96	2 19	4100	14	27.7	1.23	1.24	5.87	18.0
1737	33	20	110	6.11	2 23	4200	15	27.9	1.26	1.31	6.03	17.8
1724	33	20	110	6.25	2 27	4300	15	28.2	1.27	1.38	6.10	17.6
1712	31	19	109	6.40	2 31	4400	16	28.5	1.30	1.41	6.27	17.4
1699	31	19	108	6.54	2 35	4500	16	28.8	1.33	1.52	6.44	17.2

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or depression alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and percussion middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	°	yards.		yards.	yards.	yards.	seconds.	inches.
1685	30	18	108	6.69	2 39	4600	16	29.2	1.36	1.53	6.60	17.0
1672	28	17	107	6.73	2 43	4700	17	29.5	1.40	1.65	6.77	16.8
1658	24	17	107	6.98	2 47	4800	17	29.8	1.43	1.73	6.94	16.6
1644	27	16	106	7.13	2 51	4900	18	30.1	1.47	1.81	7.10	16.4
1631	26	16	105	7.27	2 55	5000	18	30.4	1.50	1.90	7.27	16.2
1618	25	15	104	7.42	2 59	5100	19	30.8	1.54	2.00	7.45	16.1
1606	25	15	103	7.56	3 4	5200	19	31.1	1.58	2.08	7.63	15.9
1594	24	14	102	7.71	3 8	5300	20	31.5	1.62	2.18	7.81	15.7
1581	23	14	101	7.85	3 12	5400	20	31.8	1.66	2.29	7.99	15.5
1568	23	14	100	8.00	3 17	5500	21	32.2	1.70	2.39	8.17	15.3
1555	22	13	99	8.14	3 21	5600	21	32.6	1.74	2.50	8.36	15.2
1542	22	13	98	8.29	3 26	5700	22	33.0	1.77	2.62	8.54	15.0
1529	21	13	97	8.43	3 30	5800	22	33.4	1.80	2.74	8.72	14.9
1517	20	12	96	8.58	3 34	5900	23	33.8	1.84	2.86	8.90	14.8
1504	20	12	95	8.73	3 39	6000	23	34.2	1.88	2.99	9.09	14.6
1492	20	12	93	8.87	3 44	6100	24	34.6	1.92	3.10	9.27	14.5
1480	20	12	92	9.01	3 49	6200	24	35.0	1.96	3.23	9.46	14.4
1467	19	11	91	9.16	3 53	6300	25	35.4	2.01	3.37	9.65	14.2
1455	18	11	90	9.30	3 58	6400	25	35.8	2.05	3.52	9.85	14.1
1441	17	11	89	9.45	4 4	6500	26	36.3	2.09	3.68	10.05	14.0
1428	17	10	88	9.60	4 10	6600	26	36.6	2.13	3.83	10.26	13.8
1419	16	10	87	9.74	4 15	6700	27	37.1	2.17	4.00	10.47	13.7
1407	16	10	86	9.89	4 20	6800	27	37.6	2.21	4.16	10.68	13.6
1395	16	10	85	10.03	4 25	6900	28	38.0	2.25	4.34	10.88	13.5
1384	15	9	84	10.18	4 30	7000	28	38.4	2.30	4.50	11.09	13.4
1373	15	9	83	10.32	4 36	7100	29	38.8	2.34	4.70	11.30	13.3
1362	15	9	82	10.46	4 42	7200	29	39.3	2.38	4.89	11.51	13.2
1352	15	9	81	10.60	4 47	7300	30	39.6	2.42	5.08	11.72	13.0
1340	15	9	80	10.75	4 53	7400	...	40.1	2.46	5.28	11.94	12.9
1330	14	8	79	10.89	4 59	7500	...	40.7	2.51	5.47	12.16	12.8
1320	14	8	78	11.04	5 5	7600	...	41.2	2.55	5.68	12.39	12.7
1309	13	8	77	11.19	5 11	7700	...	41.7	2.59	5.90	12.63	12.6
1298	11	7	76	11.34	5 18	7800	...	42.2	2.63	6.14	12.86	12.5
1288	11	7	75	11.48	5 24	7900	...	42.7	2.66	6.38	13.10	12.4
1279	11	7	74	11.63	5 30	8000	...	43.2	2.70	6.62	13.33	12.3
1270	11	7	73	11.77	5 37	8100	...	43.7	2.74	6.89	13.58	12.2
1260	11	7	72	11.92	5 43	8200	...	44.3	2.78	7.15	13.83	12.1
1250	11	7	71	12.07	5 49	8300	...	44.8	2.82	7.43	14.07	12.0
1242	10	6	71	12.22	5 56	8400	...	45.4	2.86	7.71	14.32	11.9
1233	10	6	70	12.36	6 4	8500	...	45.9	2.90	8.00	14.57	11.8
1223	10	6	70	12.51	6 11	8600	...	46.5	2.95	8.30	14.82	11.7
1213	10	6	69	12.65	6 18	8700	...	47.0	3.00	8.62	15.07	11.6
1201	10	6	68	12.80	6 25	8800	...	47.6	3.05	8.94	15.32	11.5
1194	9	5	67	12.94	6 32	8900	...	48.2	3.11	9.27	15.57	11.4
1185	9	5	67	13.09	6 39	9000	...	48.8	3.17	9.62	15.82	11.3
1176	9	5	66	13.24	6 46	9100	...	49.3	3.23	9.95	16.07	11.2
1167	8	5	65	13.38	6 54	9200	...	49.8	3.30	10.30	16.32	11.1
1159	8	5	64	13.53	7 1	9300	...	50.4	3.37	10.63	16.58	11.1
1150	8	5	64	13.67	7 9	9400	...	51.0	3.44	11.05	16.84	11.0
1142	8	5	63	13.81	7 17	9500	...	51.6	3.52	11.44	17.10	11.0
1134	8	5	63	13.96	7 24	9600	...	52.2	3.61	11.84	17.37	10.9
1125	7	4	62	14.11	7 32	9700	...	52.8	3.70	12.23	17.64	10.8
1118	7	4	61	14.26	7 40	9800	...	53.3	3.79	12.63	17.90	10.7
1110	7	4	60	14.40	7 48	9900	...	53.9	3.89	13.05	18.17	10.6
1102	7	4	59	14.55	7 56	10000	...	54.5	4.00	13.45	18.45	10.4
1096	7	4	58	14.69	8 5	10100	...	55.0	4.10	13.87	18.73	10.4
1090	7	4	57	14.84	8 14	10200	...	55.6	4.22	14.28	19.00	10.3
1082	7	4	56	14.98	8 22	10300	...	56.2	4.34	14.70	19.29	10.2
1075	6	4	55	15.13	8 31	10400	...	56.8	4.46	15.12	19.57	10.2
1069	6	4	55	15.27	8 40	10500	...	57.3	4.58	15.55	19.87	10.2

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or depression alters point of impact.		ELEVATION.	Fuze scale for time and percussion middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.			Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	°	yards.	yards.	yards.	yards.	seconds.	inches.
1063	6	4	54	15.42	8 49	10600	58.0	4.70	16.00	20.17	10.0
1057	6	4	53	15.56	8 58	10700	58.6	4.83	16.43	20.46	10.0
1051	6	4	53	15.71	9 8	10800	59.2	4.97	16.87	20.75	9.9
1045	5	3	52	15.86	9 17	10900	59.8	5.12	17.32	21.04	9.8
1039	5	3	51	16.00	9 26	11000	60.3	5.27	17.77	21.34	9.8
1034	5	3	50	16.15	9 36	11100	60.8	5.42	18.24	21.65	9.7
1029	5	3	49	16.29	9 46	11200	61.5	5.58	18.70	21.96	9.7
1024	5	3	48	16.43	9 55	11300	62.2	5.76	19.27	22.27	9.6
1019	5	3	47	16.58	10 5	11400	62.8	5.92	19.63	22.59	9.6
1014	5	3	45	16.73	10 16	11500	63.4	6.10	20.13	22.90	9.5
1009	5	3	45	16.88	10 25	11600	64.0	6.27	20.60	23.21	9.5
1004	5	3	44	17.02	10 36	11700	64.6	6.45	21.07	23.52	9.4
1000	5	3	44	17.17	10 46	11800	65.2	6.64	21.57	23.83	9.3
995	4	3	44	17.31	10 57	11900	65.8	6.83	22.07	24.14	9.3
990	4	3	43	17.46	11 8	12000	66.5	7.03	22.57	24.44	9.2
986	4	3	43	17.60	11 19	12100	67.1	7.23	23.08	24.75	9.2
981	4	3	43	17.75	11 30	12200	67.7	7.42	23.57	25.06	9.2
977	4	3	42	17.90	11 41	12300	68.3	7.62	24.06	25.37	9.1
973	4	2	42	18.04	11 53	12400	69.0	7.83	24.56	25.69	9.0
969	4	2	41	18.18	12 5	12500	69.6	8.03	25.09	26.00	9.0
965	4	2	40	18.33	12 16	12600	70.2	8.23	25.60	26.31	8.9
961	4	2	39	18.47	12 28	12700	70.8	8.50	26.13	26.63	8.9
957	4	2	38	18.62	12 41	12800	71.5	8.74	26.65	26.95	8.8
953	3	2	38	18.76	12 54	12900	72.0	9.00	27.18	27.27	8.8
949	3	2	37	18.90	13 7	13000	72.6	9.25	27.70	27.59	8.7
946	3	2	37	19.05	13 20	13100	73.3	9.50	28.20	27.91	8.7
943	3	2	36	19.20	13 33	13200	73.8	9.75	28.80	28.23	8.7
939	3	2	36	19.34	13 46	13300	74.5	10.00	29.27	28.55	8.6
936	3	2	35	19.49	14 00	13400	75.1	10.28	29.80	28.87	8.6
933	3	2	35	19.63	14 14	13500	75.7	10.55	30.37	29.18	8.5
929	3	2	35	19.78	14 28	13600	76.4	10.82	30.90	29.50	8.5
924	3	2	34	19.93	14 42	13700	77.1	11.12	31.45	29.84	8.4
919	3	2	34	20.07	14 56	13800	77.7	11.40	32.00	30.20	8.4

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harvey armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harvey armour, if struck direct; or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harvey armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (three-quarter charge).

Based on Practice of 5.12.98.

Minute 46,518 III.

Charge	weight, 75 lb.	Muzzle velocity, 2127 f.s.
	gravimetric density, $\frac{108.0}{0.257}$.	Nature of mounting, barbette, Mark III.
Projectile	nature, cordite, size 44.	
	nature, common shell, filled.	Jump, $7\frac{1}{4}$ minutes, negative.
	weight, 380 lb.	

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuz. scale for fuz. T. and P. middle No. 54 Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.
2111	955	573	125	0.14	0 10	100	1	...	...	...	0.14
2090	520	312	125	0.29	0 14	200	1	...	...	...	0.23
2068	358	215	124	0.43	0 18	300	1	...	...	...	0.42
2046	273	164	123	0.58	0 22	400	1	...	...	...	0.56
2026	228	137	122	0.72	0 26	500	2	...	...	...	0.71
2006	191	115	121	0.87	0 30	600	2	9	0.5	0.08	0.86
1986	163	98	120	1.01	0 34	700	2	10	0.5	0.10	1.01
1966	143	86	119	1.16	0 38	800	3	11	0.6	0.11	1.16
1948	127	76	118	1.31	0 42	900	3	11	0.6	0.14	1.31
1930	115	69	117	1.45	0 46	1000	4	12	0.6	0.17	1.47
1911	103	62	116	1.60	0 50	1100	4	12	0.7	0.20	1.63
1893	95	57	115	1.74	0 54	1200	4	13	0.7	0.22	1.80
1875	87	52	113	1.89	0 58	1300	5	13	0.7	0.25	1.97
1857	80	48	112	2.03	1 2	1400	5	14	0.8	0.29	2.14
1841	75	45	110	2.18	1 6	1500	6	14	0.8	0.32	2.31
1825	70	42	109	2.32	1 10	1600	6	15	0.8	0.36	2.48
1809	65	39	107	2.47	1 14	1700	6	16	0.9	0.40	2.65
1793	61	37	106	2.61	1 18	1800	7	17	0.9	0.44	2.82
1777	59	35	104	2.76	1 22	1900	7	18	0.9	0.50	2.98
1761	55	33	102	2.91	1 26	2000	8	19	0.9	0.57	3.15
1746	51	31	100	3.05	1 30	2100	8	19	1.0	0.63	3.32
1731	48	29	99	3.20	1 35	2200	8	20	1.0	0.69	3.50
1716	45	27	98	3.34	1 40	2300	9	21	1.1	0.75	3.67
1702	43	26	96	3.49	1 45	2400	9	21	1.1	0.81	3.85
1687	41	25	95	3.63	1 50	2500	10	22	1.1	0.88	4.02
1672	40	24	93	3.78	1 56	2600	10	23	1.2	0.95	4.19
1658	38	23	92	3.92	2 1	2700	11	23	1.2	1.02	4.37
1645	37	22	91	4.07	2 7	2800	11	24	1.2	1.10	4.55
1631	35	21	90	4.21	2 12	2900	11	24	1.3	1.17	4.73
1617	33	20	89	4.36	2 18	3000	12	25	1.3	1.25	4.92
1603	31	19	87	4.51	2 23	3100	12	25	1.3	1.28	5.11
1590	31	19	86	4.65	2 28	3200	13	26	1.4	1.30	5.30
1576	30	18	85	4.80	2 33	3300	13	27	1.4	1.45	5.48
1563	28	17	83	4.94	2 38	3400	14	28	1.4	1.60	5.66
1550	27	17	82	5.09	2 43	3500	14	28	1.4	1.70	5.85
1537	27	16	81	5.23	2 49	3600	15	29	1.5	1.80	6.05
1524	26	16	80	5.38	2 54	3700	15	29	1.5	1.90	6.24
1511	25	15	78	5.52	3 0	3800	16	30	1.5	2.0	6.44
1499	25	15	77	5.67	3 6	3900	16	30	1.6	2.1	6.64
1487	24	14	76	5.81	3 12	4000	17	31	1.6	2.2	6.85
1475	23	14	75	5.96	3 18	4100	17	31	1.6	2.3	7.05
1464	22	13	74	6.11	3 24	4200	18	32	1.6	2.4	7.26
1455	21	13	73	6.25	3 30	4300	18	32	1.7	2.5	7.46
1442	20	12	73	6.40	3 36	4400	19	33	1.7	2.6	7.67
1431	20	12	72	6.54	3 42	4500	20	33	1.7	2.8	7.88

(9784)

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RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze T. and P. middle No. 54, Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f. s.	yards.	in	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
1420	19	11	71	6.69	3 48	4600	20½	34	1.7	3.0	8.09
1409	18	11	71	6.83	3 54	4700	21½	34	1.8	3.1	8.29
1398	18	11	70	6.98	4 1	4800	21½	35	1.8	3.2	8.50
1387	17	10	69	7.13	4 7	4900	22½	35	1.8	3.4	8.72
1376	17	10	69	7.27	4 13	5000	22½	36	1.8	3.6	8.94
1365	16	10	68	7.42	4 19	5100	23½	36	1.9	3.8	9.15
1355	15	9	68	7.56	4 26	5200	24½	37	1.9	4.0	9.37
1343	15	9	67	7.71	4 33	5300	24½	37	1.9	4.1	9.58
1332	15	9	67	7.85	4 40	5400	25½	38	1.9	4.2	9.80
1321	14	9	66	8.00	4 46	5500	25½	38	2.0	4.3	10.02
1310	14	8	66	8.14	4 53	5600	26½	39	2.0	4.4	10.24
1297	13	8	65	8.29	4 59	5700	26½	39	2.0	4.6	10.46
1285	13	8	65	8.43	5 6	5800	27½	39	2.0	4.9	10.68
1274	13	8	64	8.58	5 12	5900	28½	39	2.0	5.2	10.90
1261	12	7	64	8.73	5 19	6000	28½	40	2.1	5.4	11.13
1253	12	7	63	8.87	5 26	6100	29½	40	2.1	5.6	11.36
1243	11	7	63	9.01	5 34	6200	29½	40	2.1	5.7	11.60
1233	11	7	62	9.16	5 41	6300	...	40	2.1	5.8	11.82
1223	11	7	62	9.30	5 49	6400	...	41	2.2	5.9	12.08
1213	10	6	61	9.45	5 57	6500	...	41	2.2	6.2	12.33
1203	10	6	61	9.60	6 5	6600	...	41	2.2	6.5	12.58
1194	10	6	60	9.74	6 13	6700	...	41	2.2	6.8	12.83
1185	10	6	60	9.89	6 20	6800	...	41	2.2	7.2	13.08
1176	9	6	59	10.03	6 28	6900	...	41	2.3	7.5	13.34
1168	9	6	59	10.18	6 37	7000	...	41	2.3	7.8	13.60
1160	9	6	58	10.32	6 45	7100	...	41	2.3	8.1	13.85
1152	8	5	58	10.46	6 53	7200	...	42	2.3	8.4	14.10
1141	8	5	57	10.60	7 1	7300	...	42	2.3	8.6	14.35
1137	8	5	57	10.75	7 9	7400	...	42	2.4	8.9	14.60
1130	8	5	56	10.89	7 17	7500	...	42	2.4	9.1	14.86
1124	8	5	55	11.04	7 26	7600	...	42	2.4	9.4	15.13
1117	8	5	55	11.19	7 35	7700	...	42	2.4	9.6	15.39
1110	8	5	54	11.34	7 44	7800	...	42	2.4	9.9	15.66
1103	7	5	54	11.48	7 52	7900	...	42	2.5	10.2	15.91
1096	7	4	54	11.63	8 1	8000	...	42	2.5	10.5	16.17
1089	7	4	53	11.77	8 10	8100	...	42	2.5	10.6	16.43
1083	7	4	53	11.92	8 19	8200	...	42	2.5	10.7	16.70
1076	7	4	53	12.07	8 28	8300	...	41	2.5	10.6	16.97
1070	7	4	52	12.22	8 38	8400	...	41	2.5	10.5	17.24
1064	7	4	52	12.36	8 47	8500	...	41	2.6	10.4	17.51
1058	7	4	52	12.51	8 56	8600	...	41	2.6	10.3	17.78
1053	6	4	51	12.65	9 5	8700	...	41	2.6	10.2	18.06
1048	6	4	51	12.80	9 15	8800	...	40	2.6	10.2	18.34
1042	6	4	50	12.94	9 25	8900	...	40	2.6	10.4	18.62
1036	6	4	50	13.09	9 35	9000	...	40	2.6	10.6	18.90
1030	6	3	50	13.24	9 45	9100	...	40	2.7	10.8	19.18
1025	6	3	50	13.38	9 55	9200	...	39	2.7	11.0	19.46
1020	5	3	49	13.53	10 5	9300	...	39	2.7	11.4	19.74
1015	5	3	49	13.67	10 16	9400	...	39	2.7	11.2	20.03
1010	5	3	48	13.81	10 27	9500	...	38	2.7	11.6	20.33
1005	5	3	48	13.96	10 38	9600	...	38	2.7	11.6	20.63
1000	5	3	48	14.11	10 49	9700	...	38	2.7	11.7	20.91
995	5	3	47	14.26	11 0	9800	...	37	2.7	11.8	21.20
990	5	3	47	14.40	11 10	9900	...	37	2.8	11.9	21.49
985	5	3	47	14.55	11 21	10000	...	36	2.8	12.0	21.78
981	5	3	46	14.69	11 33	10100	...	36	2.8	12.0	22.06
977	4	3	46	14.84	11 45	10200	...	35	2.8	12.3	22.34
972	4	3	45	14.98	11 57	10300	...	35	2.8	12.6	22.62
968	4	3	45	15.13	12 10	10400	...	35	2.8	12.9	22.90
964	4	3	44	15.27	12 23	10500	...	34	2.8	13.2	23.18

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact			Range.	Fuze scale for fuze T. and F. middle No. 54. Marks I, II, or III.	50 per cent. of rounds should fall within			Time of flight.
			Range.	Laterally or vertically.	ELEVATION.			Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
960	4	3	43	15.42	12 36	10600	...	34	2.8	13.5	23.46
955	4	2	42	15.56	12 49	10700	...	33	2.8	13.8	23.74
950	4	2	41	15.71	13 2	10800	...	33	2.9	14.1	24.03
946	4	2	40	15.86	13 15	10900	...	32	2.9	14.4	24.31
942	3	2	39	16.00	13 29	11000	...	32	2.9	14.7	24.60
938	3	2	38	16.15	13 42	11100	...	31	2.9	15.0	24.89
934	3	2	37	16.29	13 55	11200	...	31	2.9	15.2	25.18
929	3	2	36	16.43	14 9	11300	...	31	2.9	15.5	25.47
925	3	2	35	16.58	14 23	11400	...	30	2.9	15.7	25.75
920	3	2	35	16.73	14 36	11500	...	30	2.9	15.9	26.04
915	3	2	34	16.88	14 50	11600	...	29	2.9	16.1	26.34
910	3	2	34	17.02	15 3	11700	...	29	3.0	16.3	26.63

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.
(Composite Full Charge).

Based on Practice of 16.7.00.

40185
9259

Minute 49,687 I.

Charge	weight, 103 lb.	Muzzle velocity, 2643 f.s.
	gravimetric density, $\frac{78.8}{0.351}$	Nature of mounting, barbette, Mark III.
Projectile	nature { 99 lb. cordite, size 44; and 4 " " 31.	
	nature, cast steel, pointed, common shell, Mark II. weight, 380 lb.	Jump, $7\frac{1}{2}$ minutes, negative.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ' "	yards.	...	yards.	yards.	yards.	seconds.	ins.
2616	2385	1431	232	0.14	0 11	100	...	...	...	...	0.11	32.56
2592	1145	687	230	0.29	0 14	200	...	...	...	...	0.23	32.12
2568	767	460	228	0.43	0 16	300	...	...	...	...	0.35	31.69
2544	572	343	226	0.58	0 19	400	...	...	...	...	0.47	31.26
2520	485	275	224	0.72	0 21	500	1	...	...	...	0.59	30.84
2496	382	229	222	0.87	0 24	600	1½	20.5	0.25	0.15	0.71	30.43
2472	327	196	220	1.01	0 26	700	1½	20.7	0.28	0.16	0.83	30.03
2448	281	169	218	1.16	0 29	800	2	20.8	0.31	0.17	0.95	29.63
2424	248	149	216	1.31	0 31	900	2½	20.9	0.35	0.18	1.07	29.23
2400	220	132	214	1.45	0 34	1000	2½	21.1	0.38	0.19	1.19	28.83
2377	187	118	212	1.60	0 36	1100	3	21.3	0.40	0.20	1.31	28.43
2354	178	107	210	1.74	0 39	1200	3½	21.4	0.43	0.22	1.43	28.03
2332	163	98	208	1.89	0 41	1300	3½	21.6	0.47	0.24	1.55	27.63
2310	152	91	206	2.03	0 44	1400	4	21.7	0.50	0.26	1.68	27.23
2288	140	84	204	2.18	0 46	1500	4½	21.8	0.54	0.28	1.80	26.84
2267	130	78	202	2.32	0 49	1600	4½	22.0	0.57	0.30	1.93	26.46
2246	120	72	200	2.47	0 51	1700	5	22.2	0.59	0.32	2.06	26.07
2225	112	67	198	2.61	0 54	1800	5½	22.4	0.61	0.34	2.19	25.70
2203	105	63	196	2.76	0 57	1900	5½	22.5	0.63	0.36	2.32	25.35
2183	97	58	194	2.91	1 0	2000	6	22.6	0.66	0.38	2.46	25.00
2165	90	54	192	3.05	1 3	2100	6½	22.8	0.69	0.40	2.60	24.65
2146	85	51	190	3.20	1 6	2200	6½	23.0	0.71	0.43	2.74	24.30
2127	80	48	188	3.34	1 9	2300	7	23.2	0.74	0.48	2.88	23.96
2108	75	45	186	3.49	1 12	2400	7½	23.4	0.77	0.51	3.02	23.63
2090	71	43	184	3.63	1 15	2500	7½	23.6	0.80	0.55	3.16	23.31
2072	67	40	182	3.78	1 18	2600	8	23.8	0.83	0.59	3.30	23.00
2055	63	38	180	3.92	1 21	2700	8½	24.0	0.85	0.63	3.44	22.69
2038	60	36	178	4.07	1 24	2800	8½	24.3	0.88	0.68	3.59	22.38
2021	57	34	176	4.21	1 27	2900	9	24.5	0.90	0.73	3.73	22.09
2004	54	32	174	4.36	1 31	3000	9½	24.8	0.92	0.78	3.88	21.80
1988	52	30	172	4.51	1 34	3100	10	25.0	0.94	0.83	4.03	21.51
1972	50	29	170	4.65	1 38	3200	10½	25.2	0.97	0.88	4.18	21.22
1956	48	28	168	4.80	1 41	3300	10½	25.5	1.00	0.93	4.33	20.97
1940	46	27	166	4.94	1 45	3400	11	25.7	1.03	0.98	4.49	20.72
1925	44	26	164	5.09	1 48	3500	11½	26.0	1.05	1.03	4.64	20.47
1910	42	25	162	5.23	1 52	3600	12	26.2	1.08	1.08	4.80	20.22
1895	40	24	160	5.38	1 55	3700	12½	26.5	1.10	1.14	4.95	19.97
1880	38	23	158	5.52	1 59	3800	12½	26.8	1.13	1.20	5.11	19.73
1865	37	22	156	5.67	2 2	3900	13½	27.0	1.17	1.26	5.27	19.50
1850	35	21	154	5.81	2 6	4000	13½	27.3	1.20	1.32	5.43	19.27

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally				Length.	Breadth.	Height.		
ft. s.	yards.	1 in	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	ins.
1836	34	20	152	5.96	2 9	4100	14	27.7	1.23	1.38	5.50	19.05
1822	33	20	150	6.11	2 13	4200	14½	27.9	1.26	1.45	5.75	18.84
1809	32	19	148	6.25	2 16	4300	14½	28.2	1.27	1.52	5.91	18.62
1796	31	19	146	6.40	2 20	4400	15½	28.5	1.30	1.59	6.07	18.41
1783	30	18	144	6.54	2 23	4500	15½	28.8	1.33	1.66	6.23	18.20
1770	30	18	142	6.69	2 27	4600	16	29.2	1.36	1.74	6.40	18.00
1757	29	17	140	6.83	2 31	4700	16½	29.5	1.40	1.82	6.56	17.81
1744	28	17	138	6.98	2 35	4800	17	29.8	1.43	1.90	6.73	17.62
1731	27	16	136	7.13	2 39	4900	17½	30.1	1.47	1.98	6.89	17.43
1718	26	16	134	7.27	2 43	5000	17½	30.4	1.50	2.06	7.06	17.25
1705	25	15	132	7.42	2 47	5100	18½	30.8	1.51	2.14	7.22	17.07
1692	25	15	130	7.56	2 51	5200	18½	31.1	1.58	2.22	7.39	16.89
1679	24	14	128	7.71	2 55	5300	19	31.5	1.62	2.30	7.55	16.71
1667	23	14	126	7.85	2 59	5400	19½	31.8	1.66	2.39	7.72	16.53
1655	23	14	124	8.00	3 3	5500	20	32.2	1.70	2.46	7.89	16.36
1643	22	13	122	8.14	3 7	5600	20½	32.6	1.74	2.54	8.06	16.20
1632	22	13	120	8.29	3 11	5700	20½	33.0	1.77	2.62	8.23	16.05
1621	21	13	118	8.43	3 15	5800	21½	33.4	1.80	2.70	8.41	15.90
1610	20	12	116	8.58	3 19	5900	21½	33.8	1.84	2.78	8.58	15.75
1600	20	12	114	8.73	3 23	6000	22½	34.2	1.88	2.86	8.76	15.60
1590	19	12	112	8.87	3 27	6100	22½	34.6	1.92	2.95	8.94	15.47
1580	19	11	111	9.01	3 32	6200	23½	35.0	1.96	3.05	9.12	15.34
1570	18	11	110	9.16	3 36	6300	23½	35.4	2.01	3.16	9.30	15.22
1560	18	11	109	9.30	3 41	6400	24	35.8	2.05	3.28	9.49	15.10
1550	17	11	108	9.45	3 45	6500	24½	36.3	2.09	3.40	9.68	14.99
1540	17	10	107	9.60	3 50	6600	25	36.6	2.12	3.52	9.88	14.83
1530	17	10	106	9.74	3 54	6700	25½	37.1	2.17	3.64	10.07	14.78
1520	16	10	105	9.89	3 59	6800	26	37.6	2.21	3.77	10.27	14.68
1510	16	10	104	10.03	4 4	6900	26½	38.0	2.25	3.91	10.46	14.58
1501	15	9	103	10.18	4 9	7000	27	38.4	2.30	4.06	11.06	14.43
1491	15	9	102	10.32	4 14	7100	27½	38.8	2.34	4.22	10.85	14.38
1482	15	9	101	10.46	4 19	7200	28	39.3	2.38	4.38	11.05	14.29
1472	15	9	100	10.60	4 24	7300	28½	39.6	2.42	4.54	11.24	14.20
1463	15	9	99	10.75	4 29	7400	29	40.1	2.46	4.70	11.44	14.11
1454	14	8	98	10.89	4 34	7500	29½	40.7	2.51	4.86	11.63	14.02
1445	14	8	97	11.04	4 40	7600	30	41.2	2.55	5.0	11.83	13.93
1436	14	8	96	11.19	4 45	7700	...	41.7	2.59	5.2	12.03	13.84
1427	13	8	95	11.34	4 51	7800	...	42.2	2.63	5.4	12.23	13.76
1418	13	8	94	11.48	4 57	7900	...	42.7	2.66	5.6	12.43	13.67
1409	13	8	93	11.63	5 3	8000	...	43.2	2.70	5.8	12.64	13.59
1400	12	7	92	11.77	5 9	8100	...	43.7	2.74	6.0	12.84	13.50
1391	12	7	91	11.92	5 15	8200	...	44.3	2.78	6.2	13.05	13.42
1382	12	7	90	12.07	5 21	8300	...	44.8	2.82	6.4	13.26	13.33
1374	11	7	89	12.22	5 27	8400	...	45.4	2.86	6.6	13.47	13.25
1363	11	7	88	12.36	5 33	8500	...	45.9	2.90	6.8	13.68	13.16
1357	11	7	87	12.51	5 39	8600	...	46.5	2.95	7.0	13.90	13.08
1348	10	6	86	12.65	5 45	8700	...	47.0	3.00	7.2	14.12	12.99
1340	10	6	85	12.80	5 51	8800	...	47.6	3.05	7.4	14.34	12.91
1332	10	6	84	12.94	5 57	8900	...	48.2	3.11	7.6	14.56	12.82
1324	10	6	83	13.09	6 3	9000	...	48.8	3.17	7.8	14.79	12.74
1316	9	6	82	13.24	6 9	9100	...	49.3	3.23	8.0	15.01	12.65
1308	9	6	81	13.38	6 16	9200	...	49.8	3.30	8.3	15.24	12.57
1300	9	6	80	13.53	6 22	9300	...	50.4	3.37	8.6	15.47	12.49
1292	9	6	79	13.67	6 29	9400	...	51.0	3.44	8.9	15.70	12.41
1284	9	6	78	13.81	6 35	9500	...	51.6	3.52	9.2	15.93	12.33
1276	8	5	77	13.96	6 42	9600	...	52.2	3.61	9.5	16.17	12.25
1268	8	5	77	14.11	6 48	9700	...	52.8	3.70	9.8	16.41	12.16
1261	8	5	76	14.26	6 55	9800	...	53.3	3.79	10.1	16.66	12.08
1253	8	5	75	14.40	7 1	9900	...	53.9	3.89	10.4	16.91	11.99
1246	8	5	74	14.55	7 8	10000	...	54.5	4.00	10.7	17.16	11.91

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	°	yards.		yards.	yards.	yards.	seconds	inches.
1238	8	5	73	14.69	7 14	10100	...	55.0	4.10	11.0	17.41	11.82
1231	8	5	72	14.84	7 21	10200	...	55.6	4.22	11.3	17.66	11.74
1224	8	5	72	14.98	7 28	10300	...	56.2	4.34	11.6	17.91	11.66
1217	8	5	71	15.13	7 35	10400	...	56.8	4.46	11.9	18.16	11.58
1210	8	5	71	15.27	7 42	10500	...	57.3	4.58	12.3	18.41	11.50
1203	8	5	70	15.42	7 49	10600	...	58.0	4.70	12.7	18.67	11.42
1196	7	4	69	15.56	7 56	10700	...	58.6	4.83	13.1	18.93	11.34
1189	7	4	68	15.71	8 3	10800	...	59.2	4.97	13.5	19.19	11.27
1182	7	4	67	15.85	8 10	10900	...	59.8	5.12	13.9	19.45	11.19
1175	7	4	66	16.00	8 18	11000	...	60.3	5.27	14.3	19.72	11.12
1168	7	4	65	16.14	8 25	11100	...	60.8	5.42	14.7	19.99	11.05
1161	7	4	64	16.29	8 33	11200	...	61.5	5.58	15.1	20.26	10.98
1154	7	4	63	16.43	8 41	11300	...	62.2	5.76	15.5	20.54	10.91
1147	7	4	62	16.58	8 49	11400	...	62.8	5.92	15.9	20.82	10.84
1140	7	4	61	16.72	8 57	11500	...	63.4	6.10	16.3	21.10	10.77
1134	6	4	60	16.87	9 6	11600	...	64.0	6.27	16.7	21.39	10.70
1127	6	4	59	17.01	9 14	11700	...	64.6	6.45	17.1	21.68	10.63
1121	6	4	58	17.16	9 23	11800	...	65.2	6.64	17.5	21.98	10.56
1114	6	4	58	17.30	9 31	11900	...	65.8	6.83	17.9	22.28	10.49
1108	6	4	57	17.45	9 40	12000	...	66.5	7.03	18.3	22.58	10.42
1101	5	3	57	17.59	9 49	12100	...	67.1	7.23	18.7	22.88	10.35
1095	5	3	56	17.74	9 58	12200	...	67.7	7.42	19.1	23.18	10.28
1088	5	3	55	17.88	10 7	12300	...	68.3	7.62	19.5	23.48	10.21
1082	5	3	54	18.03	10 16	12400	...	69.0	7.83	19.9	23.78	10.15
1076	5	3	53	18.17	10 25	12500	...	69.6	8.05	20.3	24.08	10.08
1069	5	3	52	18.32	10 35	12600	...	70.2	8.26	20.7	24.39	10.02
1063	5	3	51	18.46	10 45	12700	...	70.8	8.50	21.1	24.69	9.95
1057	5	3	50	18.61	10 55	12800	...	71.5	8.74	21.5	25.00	9.89
1051	5	3	49	18.75	11 5	12900	...	72.0	9.00	21.9	25.31	9.82
1045	5	3	48	18.90	1 15	13000	...	72.6	9.25	22.3	25.62	9.76
1039	5	3	48	19.04	11 25	13100	...	73.3	9.50	22.7	25.94	9.69
1033	5	3	47	19.19	11 36	13200	...	73.8	9.75	23.1	26.26	9.63
1027	5	3	47	19.33	11 46	13300	...	74.5	10.00	23.5	26.58	9.56
1021	5	3	46	19.48	11 57	13400	...	75.1	10.28	23.9	26.91	9.50
1015	5	3	46	19.62	12 8	13500	...	75.7	10.55	24.3	27.24	9.43
1010	5	3	45	19.77	12 19	13600	...	76.4	10.82	24.7	27.57	9.37
1004	5	3	45	19.91	12 30	13700	...	77.1	11.10	25.1	27.90	9.30
999	5	3	44	20.06	12 41	13800	...	77.7	11.40	25.5	28.24	9.24
993	5	3	44	20.20	12 52	13900	...	78.4	11.70	25.9	28.58	9.17
989	5	3	44	20.35	13 3	14000	...	79.0	12.00	26.3	28.92	9.11

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

2nd October, 1900.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X. (Composite, Full Charge.)

Based on Practice of 16.7.00.

40185
9259

Minute 49,687. 1.

Charge,	weight, 103 lb.	Muzzle velocity, 2643 f.s.
	gravimetric density, $\frac{78.8}{0.351}$.	
Projectile,	nature, 99 lb. cordite, size 41; and 4 lb., size 31.	Nature of mounting, barbette, Mark IV.
	nature, cast steel, pointed, common shell, Mark II.	
	weight, 380 lb.	Jump, + 2½ minutes.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° /	yards.		yards.	yards.	yards.	seconds.	inches.
2616	2385	1431	232	0 14	0 1	100	...	...	...	...	0 11	32 56
2592	1145	687	230	0 29	0 4	200	...	...	...	...	0 23	32 12
2568	767	460	228	0 43	0 6	300	...	...	...	...	0 35	31 69
2544	572	343	226	0 58	0 9	400	...	...	...	...	0 47	31 26
2520	485	275	234	0 72	0 11	500	1	...	...	...	0 59	30 84
2496	382	229	222	0 87	0 14	600	1½	20 5	0 25	0 15	0 71	30 43
2472	327	196	220	1 01	0 16	700	1¾	20 7	0 28	0 16	0 83	30 03
2448	281	169	218	1 16	0 19	800	2	20 8	0 31	0 17	0 95	29 63
2424	248	149	216	1 31	0 21	900	2½	20 9	0 35	0 18	1 07	29 23
2400	220	132	214	1 45	0 24	1000	3	21 1	0 38	0 19	1 19	28 83
2377	197	118	212	1 60	0 26	1100	3½	21 3	0 40	0 20	1 31	28 43
2354	178	107	210	1 74	0 29	1200	4	21 4	0 43	0 22	1 43	28 03
2332	163	98	208	1 89	0 31	1300	4½	21 6	0 47	0 24	1 55	27 63
2310	152	91	206	2 03	0 34	1400	5	21 7	0 50	0 26	2 07	27 23
2288	140	84	204	2 18	0 36	1500	5½	21 8	0 54	0 28	2 19	26 84
2267	130	78	202	2 32	0 39	1600	6	22 0	0 57	0 30	2 31	26 46
2246	120	72	200	2 47	0 41	1700	6½	22 2	0 59	0 32	2 43	26 06
2225	112	67	198	2 61	0 44	1800	7	22 4	0 61	0 34	2 55	25 70
2205	105	63	196	2 76	0 47	1900	7½	22 5	0 63	0 36	3 07	25 35
2185	97	58	194	2 91	0 50	2000	8	22 6	0 66	0 38	3 19	25 00
2165	90	54	192	3 05	0 53	2100	8½	22 8	0 69	0 40	3 31	24 65
2146	85	51	190	3 20	0 56	2200	9	23 0	0 71	0 43	3 43	24 30
2127	80	48	188	3 34	0 59	2300	9½	23 2	0 74	0 46	3 55	23 96
2108	75	45	186	3 49	1 2	2400	10	23 4	0 77	0 51	4 07	23 63
2090	71	43	184	3 63	1 4	2500	10½	23 6	0 80	0 55	4 19	23 31
2072	67	40	182	3 78	1 8	2600	11	23 8	0 83	0 59	4 31	23 00
2055	63	38	180	3 92	1 11	2700	11½	24 0	0 85	0 63	4 43	22 69
2038	60	36	178	4 07	1 13	2800	12	24 3	0 88	0 68	4 55	22 38
2031	57	34	176	4 21	1 17	2900	12½	24 5	0 90	0 73	5 07	22 09
2004	54	32	174	4 35	1 21	3000	13	24 8	0 92	0 78	5 19	21 80
1988	52	30	172	4 51	1 24	3100	13½	25 0	0 94	0 83	5 31	21 51
1972	50	29	170	4 65	1 28	3200	14	25 2	0 97	0 88	5 43	21 22
1956	48	28	168	4 80	1 31	3300	14½	25 5	1 00	0 92	5 55	20 97
1940	46	27	166	4 94	1 35	3400	15	25 7	1 03	0 98	6 07	20 72
1925	44	26	164	5 09	1 38	3500	15½	26 0	1 05	1 03	6 19	20 47
1910	42	25	162	5 23	1 42	3600	16	26 2	1 08	1 08	6 31	20 22
1895	40	24	160	5 38	1 45	3700	16½	26 5	1 10	1 14	6 43	19 97
1880	38	23	158	5 52	1 49	3800	17	26 8	1 13	1 20	6 55	19 73
1865	37	22	156	5 67	1 53	3900	17½	27 0	1 17	1 26	7 07	19 50
1850	35	21	154	5 81	1 56	4000	18	27 3	1 20	1 32	7 19	19 27

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	1 in.	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	inches.
1836	34	20	152	5.96	1 59	4100	14	27.7	1.23	1.38	5.59	19.05
1822	33	20	150	6.11	2 3	4200	14½	27.9	1.26	1.45	5.75	19.84
1809	32	19	148	6.25	2 6	4300	14¾	28.2	1.27	1.52	5.91	18.62
1796	31	19	146	6.40	2 10	4400	15	28.5	1.30	1.59	6.07	18.41
1783	30	18	144	6.54	2 13	4500	15½	28.8	1.33	1.66	6.23	18.20
1770	30	18	142	6.69	2 17	4600	16	29.2	1.36	1.74	6.40	18.00
1757	29	17	140	6.83	2 21	4700	16½	29.5	1.40	1.82	6.56	17.81
1744	28	17	138	6.98	2 25	4800	17	29.8	1.43	1.90	6.73	17.62
1731	27	16	136	7.13	2 29	4900	17½	30.1	1.47	1.98	6.89	17.43
1718	26	16	134	7.27	2 33	5000	17¾	30.4	1.50	2.06	7.06	17.25
1705	25	15	132	7.42	2 37	5100	18½	30.8	1.54	2.14	7.22	17.07
1692	25	15	130	7.56	2 41	5200	18¾	31.1	1.58	2.22	7.39	16.89
1679	24	14	128	7.71	2 45	5300	19	31.5	1.62	2.30	7.55	16.71
1667	23	14	126	7.85	2 49	5400	19½	31.8	1.66	2.38	7.72	16.53
1655	23	14	124	8.00	2 53	5500	20	32.2	1.70	2.46	7.89	16.36
1643	22	13	122	8.14	2 57	5600	20½	32.6	1.74	2.54	8.06	16.20
1632	22	13	120	8.29	3 1	5700	20¾	33.0	1.77	2.62	8.23	16.05
1621	21	13	118	8.43	3 5	5800	21½	33.4	1.80	2.70	8.41	15.90
1610	20	12	116	8.58	3 9	5900	21¾	33.8	1.84	2.78	8.58	15.75
1600	20	12	114	8.73	3 13	6000	22½	34.2	1.88	2.86	8.76	15.60
1590	19	12	112	8.87	3 17	6100	22¾	34.6	1.92	2.95	8.94	15.47
1580	19	11	111	9.01	3 22	6200	23½	35.0	1.96	3.05	9.12	15.34
1570	18	11	110	9.16	3 26	6300	23¾	35.4	2.01	3.16	9.30	15.22
1560	18	11	109	9.30	3 31	6400	24	35.8	2.05	3.28	9.49	15.10
1550	17	11	108	9.45	3 35	6500	24½	36.3	2.09	3.40	9.68	14.99
1540	17	10	107	9.60	3 40	6600	25	36.6	2.13	3.52	9.88	14.89
1530	17	10	106	9.74	3 44	6700	25½	37.1	2.17	3.64	10.07	14.78
1520	16	10	105	9.89	3 49	6800	26	37.6	2.21	3.77	10.27	14.68
1510	16	10	104	10.04	3 54	6900	26½	38.0	2.25	3.91	10.46	14.58
1501	15	9	103	10.18	3 59	7000	27	38.4	2.30	4.06	10.66	14.48
1491	15	9	102	10.32	4 4	7100	27½	38.8	2.34	4.22	10.85	14.38
1482	15	9	101	10.46	4 9	7200	28	39.3	2.38	4.38	11.05	14.29
1472	15	9	100	10.60	4 14	7300	28½	39.6	2.42	4.54	11.24	14.20
1463	15	8	99	10.75	4 19	7400	29	40.1	2.46	4.70	11.44	14.11
1454	14	8	98	10.89	4 24	7500	29½	40.7	2.51	4.86	11.63	14.02
1445	14	8	97	11.04	4 30	7600	30	41.2	2.55	5.0	11.83	13.93
1436	14	8	96	11.19	4 35	7700	...	41.7	2.59	5.2	12.03	13.84
1427	13	8	95	11.34	4 41	7800	...	42.2	2.63	5.4	12.23	13.76
1418	13	8	94	11.48	4 47	7900	...	42.7	2.66	5.6	12.43	13.67
1409	13	8	93	11.63	4 53	8000	...	43.2	2.70	5.8	12.64	13.59
1400	12	7	92	11.77	4 59	8100	...	43.7	2.74	6.0	12.84	13.50
1391	12	7	91	11.92	5 5	8200	...	44.3	2.78	6.2	13.05	13.42
1382	12	7	90	12.07	5 11	8300	...	44.8	2.82	6.4	13.26	13.33
1374	11	7	89	12.22	5 17	8400	...	45.4	2.89	6.6	13.47	13.25
1365	11	7	88	12.36	5 23	8500	...	45.9	2.90	6.8	13.68	13.16
1357	11	7	87	12.51	5 29	8600	...	46.5	2.95	7.0	13.90	13.08
1348	10	6	86	12.65	5 35	8700	...	47.0	3.00	7.2	14.12	12.99
1340	10	6	85	12.80	5 41	8800	...	47.6	3.05	7.4	14.34	12.91
1332	10	6	84	12.94	5 47	8900	...	48.2	3.11	7.6	14.56	12.82
1324	10	6	83	13.09	5 53	9000	...	48.8	3.17	7.8	14.79	12.74
1316	9	6	82	13.24	5 59	9100	...	49.3	3.23	8.0	15.01	12.65
1308	9	6	81	13.38	6 6	9200	...	49.8	3.30	8.3	15.24	12.57
1300	9	6	80	13.53	6 12	9300	...	50.4	3.37	8.6	15.47	12.49
1292	9	6	79	13.67	6 19	9400	...	51.0	3.44	8.9	15.70	12.41
1284	9	6	78	13.81	6 25	9500	...	51.6	3.52	9.2	15.93	12.33
1276	8	5	77	13.96	6 32	9600	...	52.2	3.61	9.5	16.17	12.25
1268	8	5	77	14.11	6 38	9700	...	52.8	3.70	9.8	16.41	12.26
1261	8	5	76	14.26	6 45	9800	...	53.3	3.79	10.1	16.66	12.08
1253	8	5	75	14.40	6 51	9900	...	53.9	3.89	10.4	16.91	11.99
1246	8	5	74	14.55	6 58	10000	...	54.5	4.00	10.7	17.16	11.91

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks 1*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	yards.	yards.		yards.	yards.	yards.	seconds.	inches.
1238	8	5	73	14.69	7 4	10100	...	55.0	4.10	11.0	17.41	11.32
1231	8	5	72	14.84	7 11	10200	...	55.6	4.22	11.3	17.66	11.74
1224	8	5	72	14.98	7 18	10300	...	56.2	4.34	11.6	17.91	11.96
1217	8	5	71	15.13	7 25	10400	...	56.8	4.46	11.9	18.16	11.58
1210	8	5	71	15.27	7 32	10500	...	57.3	4.58	12.3	18.41	11.50
1203	8	5	70	15.42	7 39	10600	...	58.0	4.70	13.7	18.67	11.42
1196	7	4	69	15.56	7 46	10700	...	58.6	4.83	13.1	18.93	11.34
1189	7	4	68	15.71	7 53	10800	...	59.2	4.97	13.5	19.19	11.27
1182	7	4	67	15.85	8 0	10900	...	59.8	5.12	13.9	19.45	11.19
1175	7	4	66	16.00	8 8	11000	...	60.3	5.27	14.3	19.72	11.12
1168	7	4	65	16.14	8 15	11100	...	60.8	5.42	14.7	19.99	11.05
1161	7	4	64	16.29	8 23	11200	...	61.5	5.58	15.1	20.26	10.93
1154	7	4	63	16.43	8 31	11300	...	62.2	5.76	15.5	20.54	10.91
1147	7	4	62	16.58	8 39	11400	...	62.8	5.92	15.9	20.82	10.81
1140	7	4	61	16.72	8 47	11500	...	63.4	6.10	16.3	21.10	10.77
1134	6	4	60	16.87	8 56	11600	...	64.0	6.27	16.7	21.39	10.70
1127	6	4	59	17.01	9 4	11700	...	64.6	6.45	17.1	21.68	10.63
1121	6	4	58	17.16	9 13	11800	...	65.2	6.64	17.5	21.98	10.58
1114	6	4	58	17.30	9 21	11900	...	65.8	6.83	17.9	22.28	10.49
1108	6	4	57	17.45	9 30	12000	...	66.5	7.03	18.3	22.58	10.42
1101	5	3	57	17.50	9 39	12100	...	67.1	7.23	18.7	22.88	10.35
1095	5	3	56	17.74	9 48	12200	...	67.7	7.42	19.1	23.18	10.28
1088	5	3	55	17.89	9 57	12300	...	68.3	7.62	19.5	23.48	10.21
1082	5	3	54	18.03	10 6	12400	...	69.0	7.83	19.9	23.78	10.15
1075	5	3	53	18.17	10 15	12500	...	69.6	8.05	20.3	24.08	10.08
1069	5	3	52	18.32	10 25	12600	...	70.2	8.26	20.7	24.39	10.02
1063	5	3	51	18.46	10 35	12700	...	70.8	8.50	21.1	24.69	9.95
1057	5	3	50	18.61	10 45	12800	...	71.5	8.74	21.5	25.00	9.89
1051	5	3	49	18.75	10 55	12900	...	72.0	9.00	21.9	25.31	9.82
1045	5	3	48	18.90	11 5	13000	...	72.6	9.25	22.3	25.62	9.76
1039	5	3	48	19.04	11 15	13100	...	73.3	9.50	22.7	25.94	9.69
1033	5	3	47	19.19	11 26	13200	...	73.8	9.75	23.1	26.26	9.63
1027	6	3	47	19.33	11 36	13300	...	74.5	10.00	23.5	26.58	9.56
1021	5	3	46	19.48	11 47	13400	...	75.1	10.28	23.9	26.91	9.50
1015	5	3	46	19.62	11 58	13500	...	75.7	10.55	24.3	27.24	9.43
1010	5	3	45	19.77	12 9	13600	...	76.4	10.82	24.7	27.57	9.37
994	5	3	45	19.91	12 20	13700	...	77.1	11.10	25.1	27.90	9.30
999	5	3	44	20.06	12 31	13800	...	77.7	11.40	25.5	28.24	9.24
993	5	3	44	20.20	12 42	13900	...	78.4	11.70	25.9	28.58	9.17
988	5	3	44	20.35	12 53	14000	...	79.0	12.00	26.3	28.92	9.11

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1:1½:2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel if struck direct or at an angle of 30° to the normal.

2nd October, 1900.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.
(Composite Full Charge.)

Based on Practice of 16.7.00 and 30.5.01.

73
3
2844

Minutes 43,911, 49,687 I, and 51,544 (a).

Charge,	{	weight, 103 lb.	{	Muzzle velocity, 2613 f.s.
		gravimetric density, $\frac{78.8}{0.351}$		Nature of mounting, barbette, Mark V.
Projectile,	{	nature, 99 lb. cordite, size 44; and 4 lb., size 3 $\frac{1}{2}$.	{	Jump, + 1 $\frac{1}{2}$ minutes.
		nature, cast steel, pointed, com- mon shell, Mark II.		
		weight, 380 lb.		

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration, into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.	ins.
2619	2864	0 2	232	0.14	0 1	100	...	...	...	...	0.11	32.56
2596	1146	0 5	230	0.29	0 3	200	...	...	...	...	0.23	32.12
2572	767	0 7	228	0.43	0 6	300	...	...	...	...	0.35	31.69
2549	572	0 10	226	0.58	0 8	400	...	...	...	...	0.47	31.26
2526	495	0 12	234	0.72	0 11	500	1	...	...	...	0.59	30.84
2502	382	0 15	222	0.87	0 14	600	1 $\frac{1}{2}$	20.5	0.25	0.15	0.71	30.43
2483	318	0 18	220	1.01	0 16	700	1 $\frac{1}{2}$	20.7	0.28	0.16	0.83	30.03
2455	274	0 21	218	1.16	0 19	800	2	20.8	0.31	0.17	0.95	29.63
2432	239	0 24	216	1.31	0 21	900	2 $\frac{1}{2}$	20.9	0.35	0.18	1.07	29.23
2403	212	0 27	214	1.45	0 24	1000	2 $\frac{1}{2}$	21.1	0.38	0.19	1.19	28.83
2386	191	0 30	212	1.60	0 26	1100	3	21.3	0.40	0.20	1.31	28.43
2361	173	0 33	210	1.74	0 29	1200	3 $\frac{1}{2}$	21.4	0.43	0.22	1.43	28.03
2342	159	0 36	204	1.89	0 32	1300	3 $\frac{1}{2}$	21.6	0.47	0.24	1.55	27.63
2320	145	0 40	206	2.03	0 35	1400	4	21.7	0.50	0.26	1.67	27.23
2298	134	0 43	201	2.18	0 37	1500	4 $\frac{1}{2}$	21.8	0.54	0.28	1.80	26.84
2277	125	0 46	202	2.32	0 40	1600	4 $\frac{1}{2}$	22.0	0.57	0.30	1.93	26.46
2256	117	0 49	200	2.47	0 42	1700	5	22.2	0.59	0.32	2.06	26.02
2235	109	0 53	193	2.61	0 45	1800	5 $\frac{1}{2}$	22.4	0.61	0.34	2.19	25.70
2215	102	0 56	196	2.76	0 48	1900	5 $\frac{1}{2}$	22.5	0.63	0.36	2.32	25.35
2195	97	0 59	194	2.91	0 51	2000	5 $\frac{1}{2}$	22.6	0.66	0.38	2.46	25.00
2175	92	1 2	182	3.05	0 54	2100	6 $\frac{1}{2}$	22.8	0.69	0.40	2.60	24.65
2156	88	1 5	190	3.20	0 56	2200	6 $\frac{1}{2}$	23.0	0.71	0.43	2.74	24.30
2137	84	1 8	188	3.34	1 0	2300	6 $\frac{1}{2}$	23.2	0.74	0.48	2.88	23.95
2118	79	1 12	186	3.49	1 3	2400	7 $\frac{1}{2}$	23.4	0.77	0.51	3.02	23.63
2099	75	1 16	184	3.63	1 6	2500	7 $\frac{1}{2}$	23.6	0.80	0.55	3.16	23.31
2081	71	1 20	182	3.78	1 9	2600	8	23.8	0.83	0.59	3.30	23.00
2053	68	1 24	180	3.92	1 12	2700	8 $\frac{1}{2}$	24.0	0.85	0.63	3.44	22.69
2046	65	1 28	178	4.07	1 15	2800	8 $\frac{1}{2}$	24.3	0.88	0.68	3.59	22.38
2029	62	1 32	176	4.21	1 18	2900	9	24.5	0.90	0.73	3.73	22.00
2012	59	1 36	174	4.36	1 22	3000	9 $\frac{1}{2}$	24.8	0.92	0.78	3.88	21.80
1995	57	1 40	172	4.51	1 25	3100	10	25.0	0.94	0.83	4.03	21.51
1979	55	1 44	170	4.65	1 29	3200	10 $\frac{1}{2}$	25.2	0.97	0.88	4.18	21.22
1963	53	1 48	168	4.80	1 32	3300	10 $\frac{1}{2}$	25.5	1.00	0.93	4.33	20.97
1943	51	1 52	166	4.94	1 36	3400	11	25.7	1.03	0.98	4.49	20.72
1933	49	1 56	164	5.09	1 39	3500	11 $\frac{1}{2}$	26.0	1.05	1.03	4.64	20.47
1919	48	2 0	162	5.23	1 43	3600	12	26.2	1.08	1.08	4.80	20.22
1904	46	2 4	160	5.38	1 46	3700	12 $\frac{1}{2}$	26.5	1.10	1.14	4.95	19.97
1890	44	2 9	158	5.52	1 50	3800	12 $\frac{1}{2}$	26.8	1.13	1.20	5.11	19.73
1876	43	2 13	156	5.67	1 53	3900	13 $\frac{1}{2}$	27.0	1.17	1.26	5.27	19.50
1862	41	2 18	154	5.81	1 57	4000	13 $\frac{1}{2}$	27.3	1.20	1.32	5.43	19.27

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	°	yards.	yards.	°	yards.		yards.	yards.	yards.	secs.	ins.
1849	40	2 23	152	5.96	2 0	4100	14	27.7	1.23	1.38	5.59	19.05
1836	39	2 23	150	6.11	2 4	4200	14	27.9	1.26	1.45	5.75	18.84
1823	37	2 33	148	6.25	2 7	4300	14	28.2	1.27	1.52	5.91	18.62
1811	36	2 33	146	6.40	2 11	4400	15	28.5	1.30	1.59	6.07	18.41
1799	35	2 43	144	6.54	2 14	4500	15	28.8	1.33	1.66	6.23	18.20
1787	34	2 49	142	6.69	2 18	4600	16	29.2	1.36	1.74	6.40	18.00
1775	33	2 54	140	6.83	2 22	4700	16	29.5	1.40	1.82	6.56	17.81
1761	32	3 0	138	6.98	2 26	4800	17	29.8	1.43	1.90	6.73	17.62
1752	31	3 6	136	7.13	2 30	4900	17	30.1	1.47	1.98	6.89	17.43
1740	30	3 11	134	7.27	2 34	5000	17	30.4	1.50	2.06	7.06	17.25
1730	29	3 17	132	7.42	2 38	5100	18	30.8	1.54	2.14	7.22	17.07
1719	28	3 23	130	7.56	2 42	5200	18	31.1	1.58	2.22	7.39	16.89
1708	27	3 29	128	7.71	2 46	5300	19	31.5	1.62	2.30	7.55	16.71
1697	26	3 35	126	7.85	2 50	5400	19	31.8	1.66	2.38	7.72	16.53
1686	25	3 41	124	8.00	2 54	5500	20	32.2	1.70	2.46	7.89	16.36
1676	25	3 49	122	8.14	2 58	5600	20	32.6	1.74	2.54	8.06	16.20
1666	24	3 55	120	8.29	3 2	5700	20	33.0	1.77	2.62	8.23	16.05
1656	23	4 2	118	8.43	3 6	5800	21	33.4	1.80	2.70	8.41	15.90
1646	23	4 9	116	8.58	3 10	5900	21	33.8	1.84	2.78	8.58	15.75
1637	22	4 16	114	8.73	3 14	6000	22	34.2	1.88	2.86	8.76	15.60
1628	21	4 23	112	8.87	3 18	6100	22	34.6	1.92	2.95	8.94	15.47
1619	21	4 30	111	9.01	3 23	6200	23	35.0	1.96	3.05	9.12	15.34
1610	20	4 37	110	9.16	3 27	6300	23	35.4	2.01	3.16	9.30	15.22
1601	20	4 45	109	9.30	3 32	6400	24	35.8	2.05	3.28	9.48	15.10
1592	19	4 53	108	9.45	3 36	6500	24	36.3	2.09	3.40	9.68	14.99
1583	19	5 1	107	9.60	3 41	6600	25	36.6	2.13	3.52	9.88	14.88
1574	18	5 9	106	9.74	3 45	6700	25	37.1	2.17	3.64	10.07	14.78
1565	18	5 18	105	9.89	3 50	6800	26	37.6	2.21	3.77	10.27	14.68
1546	17	5 27	104	10.03	3 55	6900	26	38.0	2.25	3.91	10.46	14.58
1517	17	5 36	103	10.18	4 0	7000	27	38.4	2.30	4.06	10.66	14.48
1538	17	5 45	102	10.32	4 5	7100	27	38.8	2.34	4.22	10.85	14.38
1530	16	5 54	101	10.46	4 10	7200	28	39.3	2.38	4.38	11.05	14.29
1521	16	6 3	100	10.60	4 15	7300	28	39.6	2.42	4.54	11.24	14.20
1513	15	6 13	99	10.75	4 20	7400	29	40.1	2.46	4.70	11.44	14.11
1504	15	6 23	98	10.89	4 25	7500	29	40.7	2.51	4.86	11.63	14.02
1496	14	6 33	97	11.04	4 31	7600	30	41.2	2.55	5.0	11.83	13.93
1488	14	6 43	96	11.19	4 36	7700	...	41.7	2.59	5.2	12.03	13.84
1480	14	6 54	95	11.34	4 42	7800	...	42.2	2.63	5.4	12.23	13.76
1472	13	7 4	94	11.48	4 48	7900	...	42.7	2.66	5.6	12.43	13.67
1464	13	7 15	93	11.63	4 54	8000	...	43.2	2.70	5.8	12.64	13.59
1456	13	7 26	92	11.77	5 0	8100	...	43.7	2.74	6.0	12.84	13.50
1448	12	7 47	91	11.92	5 6	8200	...	44.3	2.78	6.2	13.05	13.42
1440	12	7 59	90	12.07	5 12	8300	...	44.8	2.82	6.4	13.26	13.33
1432	12	8 0	89	12.22	5 18	8400	...	45.4	2.86	6.6	13.47	13.25
1424	12	8 12	88	12.36	5 24	8500	...	45.9	2.90	6.8	13.68	13.16
1417	11	8 24	87	12.51	5 30	8600	...	46.5	2.95	7.0	13.90	13.08
1409	11	8 46	86	12.65	5 36	8700	...	47.0	3.00	7.2	14.12	12.99
1402	11	8 49	85	12.80	5 42	8800	...	47.6	3.05	7.4	14.34	12.91
1394	10	9 3	84	12.94	5 48	8900	...	48.2	3.11	7.6	14.56	12.82
1387	10	9 15	83	13.09	5 54	9000	...	48.8	3.17	7.8	14.79	12.74
1379	10	9 28	82	13.24	6 0	9100	...	49.3	3.23	8.0	15.01	12.65
1372	10	9 42	81	13.38	6 7	9200	...	49.8	3.30	8.3	15.24	12.57
1364	10	9 56	80	13.53	6 13	9300	...	50.4	3.37	8.6	15.47	12.49
1357	9	10 10	79	13.67	6 20	9400	...	51.0	3.44	8.9	15.70	12.41
1349	9	10 24	78	13.81	6 26	9500	...	51.6	3.52	9.2	15.93	12.33
1342	9	10 38	77	13.96	6 33	9600	...	52.2	3.61	9.5	16.17	12.25
1335	9	10 52	77	14.11	6 39	9700	...	52.8	3.70	9.9	16.41	12.16
1328	8	11 7	76	14.26	6 46	9800	...	53.3	3.79	10.1	16.66	12.08
1321	8	11 22	75	14.40	6 52	9900	...	53.9	3.89	10.4	16.91	11.99
1314	8	11 37	74	14.55	6 59	10000	...	54.5	4.00	10.7	17.16	11.91

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.	ins.
1307	8	11 52	73	14.69	7 5	10100	...	55.0	4.10	11.0	17.41	11.82
1300	8	12 8	72	14.84	7 12	10200	...	55.6	4.22	11.3	17.66	11.74
1293	8	12 23	72	14.98	7 19	10300	...	56.2	4.34	11.6	17.91	11.66
1286	7	12 38	71	15.13	7 26	10400	...	56.8	4.46	11.9	18.16	11.58
1279	7	12 53	71	15.27	7 33	10500	...	57.3	4.58	12.2	18.41	11.50
1270	7	13 9	70	15.42	7 40	10600	...	58.0	4.70	12.7	18.67	11.42
1265	7	13 24	69	15.56	7 47	10700	...	58.6	4.83	13.1	18.93	11.34
1258	7	13 40	68	15.71	7 54	10800	...	59.2	4.97	13.5	19.19	11.27
1251	7	13 55	67	15.85	8 1	10900	...	59.8	5.12	13.9	19.45	11.19
1244	7	14 11	66	16.00	8 9	11000	...	60.3	5.27	14.3	19.72	11.12
1237	6	14 26	65	16.14	8 16	11100	...	60.8	5.42	14.7	19.99	11.05
1230	6	14 42	64	16.29	8 24	11200	...	61.5	5.58	15.1	20.26	10.98
1223	6	14 58	63	16.43	8 32	11300	...	62.2	5.76	15.5	20.54	10.91
1216	6	15 15	62	16.58	8 40	11400	...	62.8	5.92	15.9	20.82	10.84
1209	6	15 31	61	16.72	8 48	11500	...	63.4	6.10	16.3	21.10	10.77
1202	6	15 48	60	16.87	8 57	11600	...	64.0	6.27	16.7	21.39	10.70
1195	6	16 4	59	17.01	9 5	11700	...	64.6	6.45	17.1	21.68	10.63
1188	6	16 21	58	17.16	9 14	11800	...	65.2	6.64	17.5	21.98	10.56
1181	6	16 37	58	17.30	9 22	11900	...	65.8	6.83	17.9	22.28	10.49
1174	5	16 54	57	17.45	9 31	12000	...	66.5	7.03	18.3	22.58	10.42
1167	5	17 11	57	17.59	9 40	12100	...	67.1	7.23	18.7	22.88	10.35
1160	5	17 28	56	17.74	9 49	12200	...	67.7	7.42	19.1	23.18	10.28
1153	5	17 45	55	17.89	9 58	12300	...	68.3	7.62	19.5	23.48	10.21
1146	5	18 3	54	18.03	10 7	12400	...	69.0	7.83	19.9	23.78	10.15
1139	5	18 20	53	18.17	10 16	12500	...	69.6	8.03	20.3	24.08	10.08
1132	5	18 38	52	18.32	10 26	12600	...	70.2	8.26	20.7	24.39	10.02
1125	5	18 55	51	18.46	10 36	12700	...	70.8	8.50	21.1	24.69	9.95
1120	5	19 13	50	18.61	10 46	12800	...	71.5	8.74	21.5	25.00	9.89
1113	5	19 31	49	18.75	10 56	12900	...	72.0	9.00	21.9	25.31	9.82
1107	5	19 49	48	18.90	11 6	13000	...	72.6	9.25	22.3	25.62	9.76
1100	5	20 7	48	19.04	11 16	13100	...	73.3	9.50	22.7	25.94	9.69
1094	4	20 25	47	19.19	11 27	13200	...	73.8	9.75	23.1	26.26	9.63
1088	4	20 43	47	19.33	11 37	13300	...	74.5	10.00	23.5	26.58	9.56
1082	4	21 1	46	19.48	11 48	13400	...	75.1	10.23	23.9	26.91	9.50
1076	4	21 19	46	19.62	11 59	13500	...	75.7	10.55	24.3	27.24	9.43
1070	4	21 38	45	19.77	12 10	13600	...	76.4	10.82	24.7	27.57	9.37
1064	4	21 56	45	19.91	12 21	13700	...	77.1	11.10	25.1	27.90	9.30
1058	4	22 15	44	20.06	12 32	13800	...	77.7	11.40	25.5	28.24	9.24
1052	4	22 32	44	20.20	12 43	13900	...	78.4	11.70	25.9	28.58	9.17
1046	4	22 52	44	20.35	12 54	14000	...	79.0	12.00	26.3	28.92	9.11

The proportional resistance to penetration of wrought iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

9th September, 1901.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.
($\frac{3}{4}$ Composite Charge).

Based on Practice of 30.7.00.

40185
9229

(Minute 49,756, III (a).)

Charge,	{	weight, 77½ lb.	{	Muzzle velocity, 2196 f.s.
		gravimetric density, $\frac{106.7}{0.260}$		
Projectile,	{	nature, { 74½ lb. cordite, size 44 and 3 lb. cordite, size 3½.	{	Nature of mounting, barbette, Mark III.
		nature, cast steel, pointed common shell, Mark II.		
		weight, 380 lb.		Jump, 7½ minutes, negative.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	° '	yards.		yards.	yards.	yards.	seconds.
2174	1908	1145	142	0.14	0 11	100	1	...	...	...	0.14
2153	818	491	140	0.29	0 14	200	2	...	...	...	0.29
2131	520	312	138	0.43	0 18	300	3	...	...	...	0.43
2110	408	245	136	0.58	0 22	400	4	...	...	...	0.58
2088	316	190	134	0.72	0 26	500	5	...	...	...	0.72
2067	260	156	132	0.87	0 30	600	6	21.0	0.35	0.1	0.89
2046	220	132	130	1.01	0 34	700	7	21.4	0.37	0.1	1.03
2025	190	114	128	1.16	0 38	800	8	21.9	0.40	0.1	1.19
2002	168	101	126	1.31	0 42	900	9	22.3	0.42	0.1	1.33
1985	146	88	124	1.45	0 46	1000	10	22.8	0.45	0.1	1.48
1965	130	78	122	1.60	0 50	1100	11	23.2	0.47	0.1	1.63
1946	120	72	121	1.74	0 54	1200	12	23.7	0.50	0.1	1.78
1927	110	66	120	1.89	0 58	1300	13	24.1	0.52	0.2	1.93
1908	100	60	119	2.03	1 2	1400	14	24.6	0.55	0.2	2.07
1890	92	55	118	2.18	1 1	1500	15	25.0	0.57	0.3	2.24
1872	85	51	117	2.32	1 10	1600	16	25.5	0.60	0.3	2.40
1855	80	48	116	2.47	1 14	1700	17	25.9	0.63	0.4	2.58
1838	75	45	115	2.61	1 18	1800	18	26.4	0.66	0.4	2.72
1821	70	42	114	2.76	1 22	1900	19	26.8	0.69	0.5	2.88
1805	65	39	113	2.91	1 26	2000	20	27.3	0.72	0.5	3.04
1789	60	36	112	3.05	1 30	2100	21	27.7	0.76	0.6	3.20
1773	56	34	111	3.20	1 34	2200	22	28.2	0.80	0.6	3.37
1757	53	32	110	3.34	1 38	2300	23	28.7	0.84	0.7	3.53
1742	50	30	109	3.49	1 42	2400	24	29.2	0.88	0.8	3.70
1727	47	28	108	3.63	1 46	2500	25	29.7	0.92	0.9	3.86
1718	45	27	107	3.78	1 51	2600	26	30.2	0.96	1.0	4.03
1699	43	26	106	3.92	1 55	2700	27	30.7	1.00	1.1	4.20
1685	41	25	105	4.07	2 0	2800	28	31.2	1.04	1.2	4.37
1671	39	24	104	4.21	2 4	2900	29	31.7	1.08	1.3	4.54
1657	37	23	103	4.36	2 9	3000	30	32.3	1.12	1.4	4.71

RANGE TABLE for 9.2-inch B.L. Gun, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Ft-zf scale for fuze, time and percussion, middle, No. 24, Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
ft.	yards.	1 in	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.
1613	35	22	102	4.51	2 14	3100	12½	32.8	1.16	1.5	4.88
1620	33	21	101	4.65	2 19	3200	12½	33.4	1.20	1.6	5.05
1616	32	20	100	4.80	2 24	3300	13½	34.0	1.24	1.7	5.22
1603	31	19	99	4.94	2 29	3400	13½	34.6	1.28	1.8	5.40
1589	30	18	98	5.09	2 32	3500	14	35.2	1.33	1.9	5.58
1576	28	17	97	5.23	2 39	3600	14½	35.8	1.38	2.0	5.76
1563	27	16	95	5.38	2 44	3700	15	36.4	1.43	2.1	5.94
1550	26	16	95	5.52	2 50	3800	15½	37.0	1.48	2.2	6.12
1537	25	15	94	5.67	2 55	3900	16	37.6	1.53	2.3	6.30
1524	24	15	93	5.81	3 1	4000	16½	38.2	1.58	2.4	6.49
1511	23	14	92	5.96	3 6	4100	17	38.8	1.63	2.6	6.68
1499	22	13	91	6.11	3 12	4200	17½	39.4	1.68	2.8	6.87
1486	21	13	90	6.25	3 17	4300	18	40.0	1.73	3.0	7.06
1474	21	12	89	6.40	3 23	4400	18½	40.6	1.78	3.2	7.26
1461	20	12	88	6.54	3 28	4500	19	41.3	1.83	3.4	7.46
1449	20	12	87	6.69	3 34	4600	19½	42.0	1.88	3.6	7.66
1436	19	11	86	6.83	3 40	4700	20	42.7	1.93	3.8	7.86
1424	19	11	85	6.98	3 46	4800	20½	43.4	1.99	4.0	8.07
1412	18	11	84	7.13	3 52	4900	21	44.1	2.04	4.2	8.27
1400	18	10	83	7.27	3 58	5000	21½	44.9	2.10	4.4	8.48
1388	17	10	82	7.42	4 4	5100	22	45.6	2.15	4.6	8.69
1376	17	10	81	7.56	4 10	5200	22½	46.4	2.21	4.8	8.90
1361	16	9	80	7.71	4 16	5300	23	47.1	2.26	5.0	9.11
1353	16	9	79	7.85	4 22	5400	23½	47.9	2.32	5.2	9.33
1341	15	9	78	8.00	4 28	5500	24	48.6	2.37	5.4	9.54
1330	15	9	77	8.14	4 34	5600	25	49.4	2.43	5.6	9.76
1319	14	8	76	8.29	4 40	5700	25½	50.2	2.49	5.9	9.98
1308	14	8	75	8.43	4 47	5800	26	51.0	2.55	6.2	10.20
1297	13	8	74	8.58	4 53	5900	26½	51.9	2.61	6.5	10.42
1287	13	8	73	8.73	5 0	6000	27	52.8	2.67	6.8	10.65
1276	12	7	72	8.87	5 7	6100	26½	53.7	2.73	7.1	10.88
1266	12	7	71	9.01	5 14	6200	28	54.6	2.80	7.4	11.11
1256	12	7	70	9.16	5 21	6300	29	55.5	2.86	7.8	11.34
1246	11	7	69	9.30	5 28	6400	29½	56.4	2.93	8.1	11.58
1235	11	7	68	9.45	5 35	6500	...	57.3	2.99	8.5	11.81
1227	11	7	67	9.60	5 42	6600	...	58.3	3.06	8.8	12.05
1218	10	6	66	9.74	5 49	6700	...	59.2	3.12	9.3	12.29
1209	10	6	65	9.89	5 57	6800	...	60.2	3.19	9.9	12.53
1200	10	6	64	10.03	6 4	6900	...	61.2	3.25	10.0	12.77
1192	10	6	63	10.18	6 12	7000	...	62.2	3.32	10.4	13.02
1184	10	6	63	10.32	6 20	7100	...	63.3	3.38	10.8	13.26
1176	9	6	62	10.46	6 28	7200	...	64.4	3.45	11.2	13.51
1168	9	6	62	10.60	6 36	7300	...	65.5	3.51	11.6	13.75
1161	9	5	61	10.75	6 44	7400	...	66.7	3.58	12.1	14.00
1154	9	5	61	10.89	6 52	7500	...	67.8	3.64	12.6	14.24
1147	9	5	60	11.04	7 0	7600	...	69.0	3.71	13.1	14.49
1140	8	5	60	11.19	7 8	7700	...	70.02	3.77	13.6	14.74
1133	8	5	59	11.34	7 16	7800	...	71.4	3.84	14.2	14.99
1126	8	5	59	11.48	7 24	7900	...	72.6	3.90	14.8	15.24
1119	8	5	58	11.63	7 33	8000	...	73.8	3.97	15.4	15.49
1112	8	5	58	11.77	7 41	8100	...	75.0	4.04	16.0	15.74
1106	8	5	57	11.92	7 50	8200	...	76.3	4.11	16.6	16.00
1100	7	4	57	12.07	7 58	8300	...	77.6	4.18	17.2	16.25
1094	7	4	56	12.22	8 7	8400	...	78.9	4.25	17.8	16.51
1088	7	4	56	12.36	8 16	8500	...	80.2	4.32	18.4	16.76
1082	7	4	55	12.51	8 25	8600	...	81.6	4.39	19.0	17.02
1076	7	4	55	12.65	8 31	8700	...	83.0	4.46	19.6	17.28
1070	7	4	54	12.80	8 44	8800	...	84.4	4.53	20.3	17.54
1064	7	4	54	12.94	8 53	8900	...	85.8	4.60	21.0	17.80
1059	7	4	53	13.09	9 3	9000	...	87.2	4.68	21.7	18.07

RANGE TABLE for 9.2-inch B.L. Gun, Marks IX and X—*continued*.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	°	yards.		yards.	yards.	yards.	secs.
1053	6	4	53	13.24	9 12	9100	...	88.6	4.75	22.4	18.34
1048	6	4	52	13.38	9 22	9200	...	90.0	4.83	23.1	18.61
1042	6	4	52	13.53	9 32	9300	...	91.4	4.91	23.8	18.89
1037	6	4	51	13.67	9 42	9400	...	92.8	4.99	24.6	19.17
1032	6	4	51	13.81	9 52	9500	...	94.2	5.07	25.4	19.45
1027	6	4	50	13.96	10 2	9600	...	95.7	5.15	26.3	19.74
1022	5	3	50	14.11	10 12	9700	...	97.2	5.23	27.1	20.03
1018	5	3	49	14.26	10 22	9800	...	98.8	5.31	28.0	20.32
1013	5	3	49	14.40	10 32	9900	...	100.3	5.39	28.9	20.61
1009	5	3	48	14.55	10 42	10000	...	101.9	5.47	29.9	20.91
1004	5	3	48	14.69	10 52	10100	...	103.5	5.55	30.9	21.21
1000	5	3	47	14.84	11 3	10200	...	105.1	5.64	32.0	21.51
996	5	3	47	14.98	11 13	10300	...	106.7	5.73	33.0	21.81
992	5	3	46	15.13	11 24	10400	...	108.3	5.82	34.1	22.12
988	5	3	46	15.27	11 35	10500	...	109.9	5.91	35.1	22.43
985	5	3	45	15.42	11 46	10600	...	111.5	6.01	36.2	22.74
982	5	3	45	15.56	11 57	10700	...	113.1	6.11	37.2	23.05
979	5	3	44	15.71	12 8	10800	...	114.7	6.21	38.3	23.36
976	4	3	44	15.85	12 19	10900	...	116.3	6.31	39.4	23.67
974	4	3	43	16.00	12 31	11000	...	117.9	6.41	40.5	23.99
972	4	3	43	16.14	12 42	11100	...	119.5	6.51	41.6	24.31
970	4	3	42	16.29	12 54	11200	...	121.1	6.61	42.7	24.63
968	4	3	42	16.43	13 6	11300	...	122.7	6.71	43.8	24.95
966	4	3	41	16.58	13 17	11400	...	124.3	6.81	45.0	25.28
964	4	3	41	16.72	13 29	11500	...	125.9	6.91	46.1	25.60
962	4	3	40	16.87	13 41	11600	...	127.5	7.01	47.3	25.93
960	4	3	40	17.01	13 53	11700	...	129.1	7.11	48.5	26.26
958	4	3	39	17.16	14 6	11800	...	130.7	7.21	49.7	26.59
956	4	3	39	17.30	14 15	11900	...	132.3	7.31	50.9	26.92
954	4	3	39	17.45	14 27	12000	...	133.9	7.41	52.1	27.26

2nd October, 1900.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X ($\frac{3}{4}$ composite charge).

Based on Practice of 30.7.00.

Minute 49,756 III.

Charge	{	weight, 77½ lb.	Muzzle velocity, 2196 f.s.
		gravimetric density, $\frac{106.7}{0.260}$	
	{	74½ lb. cordite, size 4½, and	Nature of mounting, barbette, Mark IV.
		3 lb. cordite, size 3½.	
Projectile	{	nature, cast steel, pointed, common shell, Mark II.	Jump, + 3 minutes.
		weight, 380 lb.	

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.
2174	1908	1145	142	0.14	0 1	100	1	...	...	...	0.14
2153	818	491	140	0.29	0 4	200	1	...	...	...	0.29
2131	520	312	138	0.43	0 8	300	1	...	...	...	0.43
2110	408	245	136	0.58	0 12	400	1 $\frac{1}{2}$	...	...	...	0.58
2088	316	190	134	0.72	0 16	500	1 $\frac{1}{2}$	...	...	...	0.73
2067	260	156	132	0.87	0 20	600	2	21.0	0.35	0.1	0.89
2046	220	132	130	1.01	0 24	700	2 $\frac{1}{2}$	21.4	0.37	0.1	1.03
2025	190	114	128	1.16	0 28	800	3	21.9	0.40	0.1	1.18
2002	168	101	126	1.31	0 32	900	3 $\frac{1}{2}$	22.3	0.42	0.1	1.33
1985	146	88	124	1.45	0 36	1000	3 $\frac{1}{2}$	22.8	0.45	0.1	1.48
1965	130	78	122	1.60	0 40	1100	4	23.2	0.47	0.1	1.63
1946	120	72	121	1.74	0 44	1200	4 $\frac{1}{2}$	23.7	0.50	0.1	1.78
1927	110	66	120	1.89	0 48	1300	4 $\frac{1}{2}$	24.1	0.52	0.2	1.93
1908	100	60	119	2.03	0 52	1400	5	24.6	0.55	0.2	2.09
1890	92	55	118	2.18	0 56	1500	5 $\frac{1}{2}$	25.0	0.57	0.3	2.24
1872	85	51	117	2.32	1 0	1600	6	25.5	0.60	0.3	2.40
1855	80	48	116	2.47	1 4	1700	6 $\frac{1}{2}$	25.9	0.63	0.4	2.56
1838	75	45	115	2.61	1 8	1800	6 $\frac{1}{2}$	26.4	0.66	0.4	2.72
1821	70	42	114	2.76	1 12	1900	7 $\frac{1}{2}$	26.8	0.69	0.5	2.88
1805	65	39	113	2.91	1 16	2000	7 $\frac{1}{2}$	27.3	0.72	0.5	3.04
1789	60	36	112	3.05	1 20	2100	8	27.7	0.76	0.6	3.20
1773	56	34	111	3.20	1 24	2200	8 $\frac{1}{2}$	28.2	0.80	0.6	3.37
1757	53	32	110	3.34	1 28	2300	8 $\frac{1}{2}$	28.7	0.84	0.7	3.53
1742	50	30	109	3.49	1 32	2400	9 $\frac{1}{2}$	29.2	0.88	0.8	3.70
1727	47	28	108	3.63	1 36	2500	9 $\frac{1}{2}$	29.7	0.92	0.9	3.86
1713	45	27	107	3.78	1 41	2600	10	30.2	0.96	1.0	4.03
1699	43	26	106	3.92	1 45	2700	10 $\frac{1}{2}$	30.7	1.00	1.1	4.20
1685	41	25	105	4.07	1 50	2800	11	31.2	1.04	1.2	4.37
1671	39	24	104	4.21	1 54	2900	11 $\frac{1}{2}$	31.7	1.08	1.3	4.54
1657	37	23	103	4.36	1 59	3000	11 $\frac{1}{2}$	32.3	1.12	1.4	4.71
1643	35	22	102	4.51	2 4	3100	12 $\frac{1}{2}$	32.8	1.16	1.5	4.88
1630	33	21	101	4.65	2 9	3200	12 $\frac{1}{2}$	33.4	1.20	1.6	5.05
1616	32	20	100	4.80	2 14	3300	13 $\frac{1}{2}$	34.0	1.24	1.7	5.22
1603	31	19	99	4.94	2 19	3400	13 $\frac{1}{2}$	34.6	1.28	1.8	5.40
1589	30	18	98	5.09	2 24	3500	14	35.2	1.33	1.9	5.58

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 1, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	°	'	yards.	yards.	yards.	yards.	seconds.
1576	28	17	67	5-23	2	29	3600	14½	35-8	1-38	5-76
1563	27	16	96	5-38	2	34	3700	15	36-4	1-43	5-91
1550	26	16	95	5-52	2	40	3800	15½	37-0	1-48	6-12
1537	25	15	94	5-67	2	45	3950	16	37-6	1-53	6-30
1524	24	15	93	5-81	2	51	4000	16½	38-2	1-58	6-49
1411	23	14	92	5-96	2	56	4100	17	38-8	1-63	6-63
1499	22	13	91	6-11	3	2	4200	17½	39-4	1-68	6-87
1486	21	13	90	6-25	3	7	4300	18	40-0	1-73	7-06
1474	21	12	89	6-40	3	13	4400	18½	40-6	1-78	7-26
1461	20	12	88	6-54	3	18	4500	19	41-3	1-83	7-46
1449	20	12	87	6-69	3	24	4600	19½	42-0	1-88	7-66
1436	19	11	86	6-83	3	30	4700	20	42-7	1-93	7-86
1424	19	11	85	6-98	3	36	4800	20½	43-4	1-99	8-07
1412	18	11	84	7-13	3	42	4900	21	44-1	2-04	8-27
1400	18	10	83	7-27	3	48	5000	21½	44-9	2-10	8-48
1388	17	10	82	7-42	3	54	5100	22	45-4	2-15	8-69
1376	17	10	81	7-56	4	0	5200	22½	46-6	2-21	8-90
1364	16	9	80	7-71	4	6	5300	23	47-1	2-26	9-11
1353	16	9	79	7-85	4	12	5400	23½	47-9	2-32	9-33
1341	15	9	78	8-00	4	18	5500	24½	48-6	2-37	9-54
1330	15	9	77	8-14	4	24	5600	25	49-4	2-43	9-76
1319	14	8	76	8-29	4	30	5700	25½	50-2	2-49	9-98
1308	14	8	75	8-43	4	37	5800	26	51-0	2-55	10-20
1297	13	8	74	8-58	4	43	5900	26½	51-9	2-61	10-52
1287	13	8	73	8-73	4	50	6000	27½	52-8	2-67	10-65
1276	12	7	72	8-87	4	57	6100	27½	53-7	2-73	10-68
1266	12	7	71	9-01	5	4	6200	28½	54-6	2-80	11-11
1256	12	7	70	9-16	5	11	6300	29	55-5	2-86	11-34
1246	11	7	69	9-30	5	18	6400	29½	56-4	2-93	11-58
1236	11	7	68	9-45	5	25	6500	...	57-3	2-99	11-81
1227	11	7	67	9-60	5	32	6600	...	58-3	3-06	12-05
1218	10	6	66	9-74	5	39	6700	...	59-2	3-12	12-29
1209	10	6	65	9-89	5	47	6800	...	60-2	3-19	12-53
1200	10	6	64	10-03	5	54	6900	...	61-2	3-25	12-77
1192	10	6	63	10-18	6	2	7000	...	62-2	3-32	13-02
1184	10	6	63	10-32	6	10	7100	...	63-3	3-38	13-26
1176	9	6	62	10-46	6	18	7200	...	64-4	3-45	13-51
1168	9	6	62	10-60	6	26	7300	...	65-5	3-51	13-75
1161	9	5	61	10-75	6	34	7400	...	66-7	3-58	14-00
1154	9	5	61	10-89	6	42	7500	...	67-8	3-64	14-24
1147	9	5	60	11-04	6	50	7600	...	69-0	3-71	14-47
1140	8	5	60	11-19	6	58	7700	...	70-02	3-77	14-74
1133	8	5	59	11-34	7	6	7800	...	71-4	3-84	14-2
1126	8	5	59	11-48	7	14	7900	...	72-6	3-90	14-8
1119	8	5	58	11-63	7	23	8000	...	73-8	3-97	15-4
1112	8	5	58	11-77	7	31	8100	...	75-0	4-04	15-74
1106	8	5	57	11-92	7	40	8200	...	76-3	4-11	16-00
1100	7	4	57	12-07	7	48	8300	...	77-6	4-18	16-25
1094	7	4	56	12-22	7	57	8400	...	78-9	4-25	16-51
1088	7	4	56	12-36	8	6	8500	...	80-2	4-32	16-76
1082	7	4	55	12-51	8	15	8600	...	81-6	4-39	17-02
1076	7	4	55	12-65	8	24	8700	...	83-0	4-46	17-28
1070	7	4	54	12-80	8	34	8800	...	84-4	4-53	17-54
1064	7	4	54	12-94	8	43	8900	...	85-8	4-60	17-80
1059	7	4	53	13-09	8	53	9000	...	87-2	4-68	18-07
1053	6	4	53	13-24	9	2	9100	...	88-6	4-75	18-34
1048	6	4	52	13-38	9	12	9200	...	90-0	4-83	18-61
1042	6	4	52	13-53	9	22	9300	...	91-4	4-91	18-88
1037	6	4	51	13-67	9	32	9400	...	92-8	4-99	19-17
1032	6	4	51	13-81	9	42	9500	...	94-2	5-07	19-45

. RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	1 in	yards.	yards.	°	yards.		yards.	yards.	yards.	seconds.
1027	6	4	50	13.96	9 52	9600	...	95.7	5.15	26.3	19.74
1022	5	3	50	14.11	10 2	9700	...	97.2	5.23	27.1	20.03
1018	5	3	49	14.26	10 12	9800	...	98.3	5.31	28.0	20.32
1013	5	3	49	14.40	10 22	9900	...	100.3	5.39	28.9	20.61
1009	5	3	48	14.55	10 32	10000	...	101.9	5.47	29.9	20.91
1004	5	3	48	14.69	10 32	10100	...	103.5	5.55	30.9	21.21
1000	5	3	47	14.84	10 53	10200	...	105.1	5.61	32.0	21.51
996	5	3	47	14.98	11 3	10300	...	106.7	5.73	33.0	21.81
992	5	3	46	15.13	11 14	10400	...	108.3	5.82	34.1	22.12
988	5	3	46	15.27	11 25	10500	...	109.9	5.91	35.1	22.43
985	5	3	45	15.42	11 36	10600	...	111.5	6.01	36.2	22.74
982	5	3	45	15.56	11 47	10700	...	113.1	6.11	37.2	23.05
979	5	3	44	15.71	11 58	10800	...	114.7	6.21	38.3	23.36
976	4	3	44	15.85	12 9	10900	...	116.3	6.31	39.4	23.67
974	4	3	43	16.00	12 21	11000	...	117.9	6.41	40.5	23.99
972	4	3	43	16.14	12 32	11100	...	119.5	6.51	41.6	24.31
970	4	3	42	16.29	12 44	11200	...	121.1	6.61	42.7	24.63
968	4	3	42	16.43	12 55	11300	...	122.7	6.71	43.8	24.95
966	4	3	41	16.58	13 7	11400	...	124.3	6.81	45.0	25.28
964	4	3	41	16.72	13 19	11500	...	125.9	6.91	46.1	25.60
962	4	3	40	16.87	13 31	11600	...	127.5	7.01	47.3	25.93
960	4	3	40	17.01	13 43	11700	...	129.1	7.11	48.5	26.26
958	4	3	39	17.16	13 55	11800	...	130.7	7.21	49.7	26.59
956	4	3	39	17.30	14 7	11900	...	132.3	7.31	50.9	26.92
954	4	2	39	17.45	14 19	12000	...	133.9	7.41	52.1	27.26

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harvey armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harvey armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harvey armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

2nd October, 1900.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.
($\frac{3}{4}$ Composite Charge.)

Based on Practice of 30.7.00 and 11.6.01.

40185
9191

(Minutes 43,941, 49756 III, and 51,544.)

Charge,	{	weight, 77½ lb.	Muzzle velocity, 2,196 f.s.
		gravimetric density, $\frac{106.7}{0.260}$	
{	{	nature, { 7½ lb. cordite, size 44, and	Nature of mounting, Barbette, Mark V.
		3 " " " 3½.	
Projectile,	{	nature, cast steel, pointed, com-	Jump, nil.
		mon shell, Mark II.	
{	{	weight, 380 lb.	

Remaining velocity. (Actual.)	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	Range.	Fuze scale for time fuze, and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.						Length.	Breadth.	Height.	
f.s.	yards.	yards.	yards.	°	'	yards.		yards.	yards.	yards.	secs.
2177	142	0.14	1432	0 4	0 3	100	1	...	...	...	0.14
2158	140	0.29	714	0 8	0 7	200	1	...	...	...	0.29
2139	138	0.43	477	0 12	0 11	300	1	...	...	...	0.43
2120	136	0.58	358	0 16	0 15	400	1½	...	...	...	0.58
2091	134	0.72	286	0 20	0 19	500	1½	...	...	...	0.72
2083	132	0.87	229	0 25	0 23	600	2	21.0	0.35	0.1	0.83
2065	130	1.01	197	0 29	0 27	700	2½	21.4	0.37	0.1	1.03
2047	128	1.16	169	0 34	0 31	800	2½	21.9	0.40	0.1	1.18
2029	126	1.31	151	0 38	0 35	900	3½	22.3	0.42	0.1	1.33
2011	124	1.45	133	0 43	0 39	1000	3½	22.8	0.45	0.1	1.48
1993	122	1.60	122	0 47	0 43	1100	4	23.2	0.47	0.1	1.63
1975	121	1.74	110	0 52	0 47	1200	4½	23.7	0.50	0.1	1.78
1958	120	1.89	100	0 57	0 51	1300	4½	24.1	0.52	0.2	1.93
1941	119	2.03	92	1 2	0 55	1400	5	24.6	0.55	0.2	2.09
1924	118	2.18	87	1 6	0 59	1500	5½	25.0	0.57	0.3	2.24
1907	117	2.32	81	1 11	1 3	1600	6	25.5	0.60	0.3	2.40
1890	116	2.47	75	1 16	1 7	1700	6½	25.9	0.63	0.4	2.56
1874	115	2.61	71	1 21	1 11	1800	6½	26.4	0.66	0.4	2.72
1858	114	2.76	66	1 26	1 15	1900	7½	26.8	0.69	0.5	2.88
1842	113	2.91	63	1 31	1 19	2000	7½	27.3	0.72	0.5	3.04
1826	112	3.05	59	1 36	1 23	2100	8	27.7	0.76	0.6	3.20
1810	111	3.20	56	1 41	1 27	2200	8½	28.2	0.80	0.6	3.37
1794	110	3.34	54	1 46	1 31	2300	8½	28.7	0.84	0.7	3.53
1778	109	3.49	51	1 52	1 35	2400	9½	29.2	0.88	0.8	3.70
1762	108	3.63	49	1 57	1 39	2500	9½	29.7	0.92	0.9	3.86
1747	107	3.78	46	2 3	1 44	2600	10	30.2	0.96	1.0	4.03
1732	106	3.92	44	2 9	1 48	2700	10½	30.7	1.00	1.1	4.20
1717	105	4.07	42	2 15	1 53	2800	11	31.2	1.04	1.2	4.37
1702	104	4.21	40	2 21	1 57	2900	11½	31.7	1.08	1.3	4.54
1687	103	4.36	39	2 27	2 2	3000	11½	32.3	1.12	1.4	4.71
1672	102	4.51	37	2 33	2 7	3100	12½	32.8	1.16	1.5	4.88
1658	101	4.65	36	2 39	2 12	3200	12½	33.4	1.20	1.6	5.05
1644	100	4.80	34	2 45	2 17	3300	13	34.0	1.24	1.7	5.22
1630	99	4.94	33	2 52	2 22	3400	13½	34.6	1.28	1.8	5.40
1616	98	5.09	32	2 59	2 27	3500	14	35.2	1.33	1.9	5.58

(9784)

1 2

RANGE TABLE for 9.2-inch B.L. Guns—continued.

Remaining velocity. (Actual.)	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	RANGE.	Fuz. scale for time fuse, and percussion, middle, No. 84, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.						Length.	Breadth.	Height.	
f.s.	yards.	yards.	yards.	° '	° '	yards.		yards.	yards.	yards.	secs.
1603	87	5.23	31	3 6	2 32	3600	14½	35.8	1.38	2.0	5.76
1688	96	5.38	29	3 13	2 37	3700	15	36.4	1.43	2.1	5.94
1675	95	5.52	28	3 21	2 43	3800	15½	37.0	1.48	2.2	6.12
1662	94	5.67	27	3 28	2 48	3900	16	37.6	1.53	2.3	6.30
1549	13	5.81	26	3 36	2 54	4000	16½	38.2	1.58	2.4	6.49
1536	92	5.96	25	3 44	2 59	4100	17	38.8	1.63	2.6	6.68
1524	91	6.11	24	3 52	3 5	4200	17½	39.4	1.68	2.8	6.87
1512	90	6.25	24	4 0	3 10	4300	18	40.0	1.73	3.0	7.06
1500	89	6.40	23	4 9	3 16	4400	18½	40.6	1.78	3.2	7.26
1488	88	6.54	22	4 17	3 21	4500	19	41.3	1.83	3.4	7.46
1476	87	6.69	22	4 26	3 27	4600	19½	42.0	1.88	3.6	7.66
1464	86	6.83	21	4 35	3 33	4700	20	42.7	1.93	3.8	7.86
1453	85	6.98	20	4 44	3 39	4800	20½	43.4	1.99	4.0	8.07
1442	84	7.13	19	4 53	3 45	4900	21	44.1	2.04	4.2	8.27
1431	83	7.27	19	5 3	3 51	5000	21½	44.9	2.10	4.4	8.48
1421	82	7.42	18	5 13	3 57	5100	22	45.6	2.15	4.6	8.69
1411	81	7.56	18	5 23	4 3	5200	22½	46.4	2.21	4.8	8.90
1401	80	7.71	17	5 33	4 9	5300	23	47.1	2.26	5.0	9.11
1391	79	7.85	17	5 43	4 15	5400	23½	47.9	2.32	5.2	9.33
1381	78	8.00	16	5 53	4 21	5500	24	48.6	2.37	5.4	9.54
1371	77	8.14	16	6 4	4 27	5600	25	49.4	2.43	5.6	9.76
1361	76	8.29	15	6 15	4 33	5700	25½	50.2	2.49	5.9	9.98
1351	75	8.43	15	6 26	4 40	5800	26	51.0	2.55	6.2	10.20
1341	74	8.58	14	6 27	4 46	5900	26½	51.9	2.61	6.5	10.42
1332	73	8.73	14	6 48	4 53	6000	27	52.8	2.67	6.8	10.65
1323	72	8.87	13	6 59	5 0	6100	27½	53.7	2.73	7.1	10.88
1314	71	9.01	13	7 11	5 7	6200	28	54.6	2.80	7.4	11.11
1305	70	9.16	13	7 22	5 14	6300	29	55.5	2.86	7.8	11.34
1297	69	9.30	12	7 34	5 21	6400	29½	56.4	2.93	8.1	11.58
1289	68	9.45	12	7 46	5 28	6500	...	57.3	2.99	8.5	11.81
1281	67	9.60	12	7 58	5 35	6600	...	58.3	3.06	8.8	12.05
1273	66	9.74	11	8 9	5 42	6700	...	59.2	3.12	9.2	12.29
1265	65	9.89	11	8 21	5 50	6800	...	60.2	3.19	9.6	12.53
1257	64	10.03	11	8 33	5 57	6900	...	61.2	3.25	10.0	12.77
1250	63	10.18	11	8 45	6 5	7000	...	62.2	3.32	10.4	13.02
1242	62	10.32	10	8 57	6 13	7100	...	63.3	3.38	10.8	13.26
1235	62	10.46	10	9 10	6 21	7200	...	64.4	3.45	11.2	13.51
1227	62	10.60	10	9 23	6 29	7300	...	65.5	3.51	11.6	13.75
1220	61	10.75	9	9 36	6 37	7400	...	66.7	3.58	12.1	14.00
1213	61	10.89	9	9 49	6 45	7500	...	67.8	3.64	12.6	14.24
1206	60	11.04	9	10 3	6 53	7600	...	69.0	3.71	13.1	14.49
1199	60	11.19	9	10 17	7 1	7700	...	70.02	3.77	13.6	14.74
1193	59	11.34	9	10 31	7 9	7800	...	71.4	3.84	14.2	14.99
1187	59	11.48	8	10 45	7 17	7900	...	72.6	3.90	14.8	15.24
1181	58	11.63	8	11 0	7 26	8000	...	73.8	3.97	15.4	15.49
1175	58	11.77	8	11 15	7 34	8100	...	75.0	4.04	16.0	15.74
1170	57	11.92	8	11 30	7 43	8200	...	76.3	4.11	16.6	16.00
1165	57	12.07	8	11 45	7 51	8300	...	77.6	4.18	17.2	16.25
1160	56	12.22	7	12 1	8 0	8400	...	78.9	4.25	17.8	16.51
1155	56	12.36	7	12 17	8 9	8500	...	80.2	4.32	18.4	16.76
1150	55	12.51	7	12 33	8 18	8600	...	81.6	4.39	19.0	17.02
1145	55	12.65	7	12 49	8 27	8700	...	83.0	4.46	19.6	17.28
1141	54	12.80	7	13 6	8 37	8800	...	84.4	4.53	20.3	17.54
1137	54	12.94	7	13 22	8 46	8900	...	85.8	4.60	21.0	17.80
1133	53	13.09	6	13 39	8 56	9000	...	87.2	4.68	21.7	18.07
1129	53	13.24	6	13 56	9 5	9100	...	88.6	4.75	22.4	18.34
1126	52	13.39	6	14 13	9 15	9200	...	90.0	4.83	23.1	18.61
1122	52	13.53	6	14 30	9 25	9300	...	91.4	4.91	23.8	18.89
1119	51	13.67	6	14 48	9 35	9400	...	92.8	4.99	24.6	19.17
1116	51	13.81	6	15 6	9 45	9500	...	94.2	5.07	25.4	19.45

RANGE TABLE for 9.2-inch B.L. Guns—*continued*.

Remaining velocity. (Actual.)	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	Range.	Fuze scale for time fuze, and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.						Length.	Breadth.	Height.	
f. s.	yards.	yards.	yards.	° /	° /	yards.		yards.	yards.	yards.	secs.
1113	50	13.96	6	15 24	9 55	9600	...	85.7	5.15	26.3	19.74
1110	50	14.11	6	15 42	10 5	9700	...	97.2	5.23	27.1	20.03
1107	49	14.26	5	16 0	10 15	9800	...	98.8	5.31	28.0	20.32
1104	49	14.40	5	16 18	10 25	9900	...	100.3	5.39	28.9	20.61
1101	48	14.55	5	16 37	10 35	10000	...	101.9	5.47	29.9	20.91
1097	48	14.69	5	16 54	10 45	10100	...	103.5	5.55	30.9	21.21
1095	47	14.84	5	17 14	10 56	10200	...	105.1	5.64	32.0	21.51
1092	47	14.98	5	17 33	11 6	10300	...	106.7	5.73	33.0	21.81
1090	46	15.13	5	17 52	11 17	10400	...	108.3	5.82	34.1	22.12
1087	46	15.27	5	18 11	11 28	10500	...	109.9	5.91	35.1	22.43
1085	45	15.42	5	18 30	11 39	10600	...	111.5	6.01	36.2	22.74
1082	45	15.56	4	18 49	11 50	10700	...	113.1	6.11	37.2	23.05
1080	44	15.71	4	19 9	12 1	10800	...	114.7	6.21	38.3	23.36
1078	44	15.85	4	19 28	12 12	10900	...	116.3	6.31	39.4	23.67
1076	43	16.00	4	19 48	12 24	11000	...	117.9	6.41	40.5	23.99
1074	43	16.14	4	20 8	12 35	11100	...	119.5	6.51	41.6	24.31
1072	42	16.29	4	20 28	12 47	11200	...	121.1	6.61	42.7	24.63
1070	42	16.43	4	20 48	12 58	11300	...	122.7	6.71	43.8	24.95
1068	41	16.58	4	21 9	13 10	11400	...	124.3	6.81	45.0	25.28
1066	41	16.72	4	21 29	13 22	11500	...	125.9	6.91	46.1	25.60
1064	40	16.87	4	21 50	13 34	11600	...	127.5	7.01	47.3	25.98
1062	40	17.01	4	22 10	13 46	11700	...	129.1	7.11	48.5	26.26
1060	39	17.16	4	22 31	13 58	11800	...	130.7	7.21	49.7	26.59
1058	39	17.30	4	22 51	14 10	11900	...	132.3	7.31	50.9	26.92
1056	39	17.45	3	23 12	14 22	12000	...	133.9	7.41	52.1	27.26

7th October, 1931.

RANGE TABLE for 1-inch Aiming Tube.

Based on Practice of 25.600.

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161

Minute, 49629 (a) and (b).

AMMUNITION, ELECTRIC, AIMING RIFLE, MARK IV, M. OR K.N., OR
PERCUSSION, MARK I.

Muzzle velocity, 1100 f.s.

Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	50 per cent. of rounds should fall in.		
	Range.	Vertically or laterally.			Length.	Breadth.	Height.
1 in.	yards.	yards.	degs. mins.	yards.	yards.	yards.	yards.
343	31	0.14	0 16	100			
149	31	0.29	0 32	200			
90	30	0.43	0 48	300			
61	30	0.58	1 4	400			
45	29	0.72	1 21	500			
35	29	0.87	1 39	600	10.0	0.36	0.20
28	28	1.01	1 55	700	10.3	0.38	0.40
23	27	1.16	2 12	800	10.7	0.40	0.52
19	27	1.31	2 30	900	11.2	0.43	0.64
16	26	1.45	2 49	1000	11.8	0.46	0.78
14	25	1.60	3 9	1100	12.5	0.50	0.94
12	25	1.74	3 30	1200	13.2	0.55	1.12
10	24	1.89	3 52	1300	13.9	0.61	1.32
9	23	2.03	4 15	1400	14.7	0.69	1.56
8	22	2.18	4 38	1500	15.6	0.77	1.84
7	21	2.32	5 1	1600	16.6	0.87	2.16
7	20	2.47	5 25	1700	17.7	0.98	2.53
6	19	2.61	5 50	1800	18.9	1.10	2.96
6	18	2.76	6 16	1900	20.1	1.23	3.44
5	18	2.91	6 43	2000	21.4	1.37	3.97
5	18	3.05	7 10	2100	22.7	1.53	4.55
5	17	3.20	7 38	2200	24.0	1.70	5.20
4	17	3.34	8 6	2300	25.3	1.87	5.90
4	17	3.49	8 34	2400	26.6	2.05	6.64
4	17	3.63	9 2	2500	28.0	2.25	7.40

NOTE.—When firing over water at 1,000 yards range, the bullets ricocheted about 1,200 yards more, coming to rest at a range of about 2,200 yards.

16th October, 1900.

DRILL FOR 9.2-INCH B.L. GUN ON BARBETTE MOUNTING (MARK II).

GUN DETACHMENT.

A gun detachment consists of a Gun Captain, a Gun Layer, and nine other gun numbers.

It falls in and is told off as laid down in G. A. Drill, Vol. II, 1899, Page 10.

TO PREPARE FOR ACTION.

<i>Gun Group Commander.</i>	|	<i>Gun Captain.</i>
“A Group Prepare for Action.”		“A 1 Prepare for Action.”

At “*Prepare for Action*” each number brings up his stores as follows:—

Gun Captain.—Key of hydro-clinometer when used.

Gun Layer.—Sights, tubes, tube box, battery and key, test and firing, lanyards, rimer, percussion or electric lock, and wrench breech action, or wrench firing mechanism. For drill a drill tube.

N.B.—A pocket is supplied to hold the rimer which the Gun Layer straps round his waist.

No. 2.—Side arms (combined rammer and sponge, and scraper with brush), loading trays, and handle of control gear.

No. 3.—Traversing handles, oil can, Russian tallow, waste, and McMahon spanner.

No. 4.—Elevating wheel and assists 2.

No. 5.—Elevating wheel and winch handle.

No. 6.—Assisted by 9, bucket filled with water, a sponge cloth and brush, and for drill zinc cylinders containing drill cartridges.

Nos. 7 and 8.—Transporting barrow, brush, two selvagees, fuzes, two fuze keys, and a piece of chalk. For drill a drill shell.

No. 10.—Assists 2 and 4 with side arms and loading trays.

The following group stores are supplied and should be laid down in the places allotted to them, distributed between the various groups of guns:—Cartridge extractors, 1 per 3 guns or less; hammers 2 per battery; clinometers 1 per work; keys, tampeon, 1 per 2 guns or less number; vent bit 1 per work, lever extractor 1 per 10 guns or less. For drill 1 drill shell extractor per gun.

These additional stores will be brought up by Nos. 6 and 7 of the guns they are intended for.

Gun Layer receives the tubes from the shell store, fixes the sights in the gun, taking care that the foresights fit correctly and the deflection leaves of the hind sights work easily, fixes in position the battery and key, test and firing, and makes the necessary connections, connects up the electric lanyard, placing the percussion lanyard, with the tubes, in a convenient position on the mounting, if percussion firing is used, makes fast the lanyard to the sighting post, and having examined the lock places it in position in the breech block. Sees that the pointer for traversing arc is let down.

Nos. 2 and 4 arrange sidearms on the right of the gun, heads to the front, combined rammer and sponge next the gun, then scraper, the loading trays being placed on top of the counter-weight in rear of the slide. 2 puts on handle of control gear if fitted. 4 puts on elevating wheel on his own side.

No. 3 places the oil can, Russian tallow, and waste in a convenient position on the mounting or emplacement, ships the traversing handles, and removes breech and muzzle cover and tampon, placing them on the right of position of No. 5 when under cover.

No. 5 puts on elevating wheel on his own side, places the winch-handle on the gun floor close to the derrick.

No. 6 places the bucket and brush near the side arms, and assisted by 9, loosens or removes bands from covers of cylinders if not already done. At drill the drill cartridges and cylinders are placed outside the cartridge store.

No. 7 gives a fuze key to the Gun Captain if time, or to 3 if percussion, fuzes are going to be used, and places the other stores outside the shell store.

The Gun Captain now sees that the buffers are filled with the proper amount of oil, that the gun and mounting is ready and fit in all respects for firing. He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, and stores. When firing with P.F. he sees that the firing plug is ready for use.

Nos. 2 and 3 open and close the breech, 4 and 5 elevating or depressing the gun into a convenient position. When opened the Gun Captain looks through and sees that the bore is clear.

TO OPEN AND CLOSE THE BREECH.

No. 2 raises the cam lever into its upright position, 3 raises the ratchet lever to its full extent (sees that the ratchet catches) and with both hands forces it down till the cam lever is against stop, 2 then starts the movement of the breech-screw by lowering the cam lever, raising it into its upright position again, 2 and 3 then withdraw the breech-screw, and, when clear, swing it round on its carrier ring.

No. 2 then examines the breech-screw and sees that it is clean and the threads free from burrs, lubricating them with a slight film of oil, and rubbing the asbestos pad with Russian tallow. 3 examines the bore, chamber and threads of breech, also lubricating the threads with a slight film of oil.

"To close the breech," 2 assisted by 3 swings round the breech-screw, and pushes it home. 3 works the ratchet lever until the cam lever can be folded down by 2, 3 then releases the ratchet lever and allows it to fall into its place.

If the gun is fitted with control gear, 3 withdraws and inserts the breech-screw by its means; in this case the cam lever will not be folded down when opening the breech.

When the breech is closed the Gun Layer fires a tube, sees that the lock is in good order, and rimes out the vent.

N.B.—Before firing the tube, the Gun Captain will see that no one is in front of the muzzle, and will also be responsible that no charge is in the gun.

No. 2 sees that the traversing gear and 4 that the elevating gear is oiled and in working order.

After the numbers have completed their work as above, they take up their positions under cover as follows; they should then, if possible, be sitting or lying down.

Gun Captain.—Where he can best regain his position for superintending the working of the gun.

Gun Layer.—On the left of No. 10.

Nos. 2, 4, and 10.—On the right of gun.

Nos. 3 and 5.—On the left of the gun.

Nos. 2 and 3 being next the muzzle, and 4, 5 and 10 outside them.

Nos. 6 and 9.—At the head of the cartridge lift, or outside the cartridge store.

Nos. 7 and 8.—At the head of shell lift, or outside the shell store.

TO LOAD.

Gun Group Commander.

"A Group."

".... Load."

Gun Captain.

"A 1."

".... Load."

When using electric tubes, the Gun Layer attaches one tube wire to the terminal on the gun.

Nos. 2, 3, 4, and 5 mount on the loading stage, 2 and 3 open the breech as before detailed, 3 receives the rear portion of the loading tray from 4 (or from 10 if it is not on the counter-weight) and places it in the chamber. The front portion will not be used for loading.

Nos. 7 and 8 bring up the projectile on its barrow; if using time fuze the Gun Captain will set it, 5 attends to the derrick, 8 hooks the derrick tackle to the selvagee, 7 and 8 shipping and manning the winch handle, raise the projectile, 5 steadying it, and when high enough swinging it in towards the breech of the gun; 2 and 3 then steady and guide the projectile, and when over the loading tray 3 holds up his hand as a signal to ease off, which is done by 5 by means of the break; as soon as the projectile is lowered on to the tray 2 casts loose the selvagee, 3 uncaps the fuze or removes the safety pins, 5 swings the derrick clear, 7 and 8 unship the winch handle, 10 supplies the combined rammer and sponge to 2 and 3, and it is manned by 2 and 4 on the right, 3 and 5 on the left side; the projectile is then rammed home in one motion; when home, 2 and 3 sponge out the chamber by giving the combined rammer and sponge two half turns to the left, and withdraw it hand over hand with a corkscrew motion. When withdrawn the sponge head will be thoroughly saturated with water before loading the next round.

Nos. 6 and 9 bring up the cartridges in zinc cylinders with lids unscrewed on each side of the slide, 6 on the right, 9 on the left, and withdraw them from the cylinders, handing them to 2 and 3, who place them in the chamber separately, pushing them home by hand or using the combined rammer and sponge, turned end for end, if necessary; 3 removes the shalloon patch from end of last cartridge, withdraws the rear portion of loading tray, and hands it to 4 or 10, who replaces it and the combined rammer and sponge; the breech is then closed as before detailed. 2, 3, 4, and 5 dismount from the loading stage. Gun Layer places a tube in the vent.* With electric firing, connects the second tube wire to the terminal on the lock and folds down the cam lever.†

* The tube is never to be inserted *before* the breech is properly closed under any pretext whatever.

† When firing paper proof shot, made up in more than one portion, the gun will not be loaded or fired at an angle of depression.

TO LAY AND FIRE.†

With percussion firing the Gun Layer folds down the cam lever and hooks the lanyard immediately before going to his sighting step.

Nos. 2, 3, 9, and 10, man the traversing handles; 10 first raising the slide into the traversing position by working the handle of the floating pivot pump; 4 and 5 the elevating wheels.

The remaining numbers go under cover.

N.B.—When firing at a moving object, and using tangent sights for direction, the gun and slide must be kept in the raised position on the pivot, in order that the traversing may be easily and quickly performed, and the sights kept on the target.

When P.F. Case III is used, or when firing at a standing or moored target the gun and slide will be lowered on to the pivot before firing.

The lowering of the gun and slide increases the elevation about five minutes; this must be allowed for when the gun is laid, whether by tangent scale or Q.E. before being lowered.

ELECTRIC FIRING.

See G.A. Drill, Vol. II, 1899, page 31.

MISS-FIRES.

See G.A. Drill, Vol. II, 1899, page 22.

SCRAPING AND BRUSHING OUT.

As soon as the gun is fired, the Gun Captain removes the firing plug if electric firing is used, 2 and 3 open the breech, the Gun Layer unhooks the lanyards, extracts the old tube and rimes out the vent (with P.F. Case III, coils up the electric lanyard and puts it in the safety firing plug box). 4 supplies 2 with the sponge cloth thoroughly saturated with water, 2 hangs it over the mushroom head. The G.C. inspects the chamber to see whether it is necessary to use the scraper, and if he considers it to be so, will order the gun to be scraped and brushed out. 4 then supplies the scraper with brush to 3, who scrapes and brushes out the residue from previous rounds, being careful that the threads in the breech are not choked with it. 4 replaces the scraper and brush.

TO CEASE FIRING.

On the command "Cease Firing," the cam lever will be raised with the D percussion lock. When firing with P.F. Case III, the firing plug only will be removed by the Gun Captain. When firing by electricity one wire from the firing battery will be disconnected, except in Case III or when using the battery and key test and firing Mark III, Mark III,* or Mark IV, when the firing plug only will be removed by the G.C.

TO CEASE FIRING AND REPLACE STORES.

Gun Group Commander.

Gun Captain.

"A Group Cease Firing and
Replace Stores."

"A 1 Cease Firing and Replace
Stores."

The stores are returned by the numbers who brought them up.

† See G.A. Drill, Vol. II, 1899, page 26.

After replacing stores, the detachment falls in two-deep in rear of the gun, as at first.

Gun Captain will see that the gun is run up so as not to expose the piston rod, and the gun at an angle of depression of about 4°.

TO RUN BACK AT DRILL.

If necessary the guns on these mountings can be run back as follows:—

A special derrick is attached to the bracket of the carriage on the right side, and by a hoisting tackle attached to it, the pump is hoisted high enough to allow a projection on the bottom of it, to rest in a recess in the bracket of carriage. It is now clamped in this position by two clamps attached to bracket. The connecting pipe is attached to delivery on pump and to filling hole in rear of the right buffer. By attaching and working the pump handle, the gun can be run back the required amount.

NOTE.—The pump is also used in this manner for filling the buffers, or they may also be filled in the ordinary manner, but owing to the small aperture at the filling hole, it takes a considerable time.

When running back, the by-pass valve of the pump must be kept closed, and opened to run up again, the Gun Layer attending to the valve.

The pump should be removed from the carriage before firing.

Nos. 4 and 10 bring up and attach the pump handle, which is manned by 4, 7, 8, and 10.

TO UNLOAD AT DRILL.

The gun is unloaded by the same numbers as loaded it, but both portions of the loading tray are used. The rear portion is supplied by 4 or 10 to 3, who places it in the gun. The cartridges are then unloaded by 2 and 3. 4 or 10 then supply the front portion of the loading tray to 2, who places it in the chamber, being careful to see that the projections are engaged in the rear part. As soon as the projectile is withdrawn, the loading trays are removed by 2 and 3 and replaced by 4 and 10.

2 places the sponge cloth over the mushroom head, having received it *dry at drill* from 4, the G.C. inspects the chamber, and orders the scraper to be used if required, in which case the scraper is used as before detailed.

TO TAKE POST UNDER COVER AND FORM DETACHMENT REAR.

See G.A. Drill, Vol. II, page 11.

DRILL FOR 9.2-INCH B.L. GUN ON BARBETTE MOUNTING (MARK I).

The drill is the same as with Mark II mounting, with the following exceptions:—

TO PREPARE FOR ACTION.

No. 5 does not bring up elevating wheel—brings up hoisting tackle, and rigs it.

Nos. 2 and 4 place the loading trays beside the combined rammer and sponge next to the gun.

TO LOAD.

Nos. 2 and 3 mount on to the slide, open the breech, and 3 receives the loading tray from 4 or 10, and places it in the chamber.

The projectile is eased off when over the loading stage by 7 and 8. 5 swings in the projectile by means of the derrick lever.

GUN LOADED IN RUN BACK POSITION.

If the gun is loaded when run back, 2 and 3 do not mount on to slide, 4 elevates the gun into the loading position, and the loading is proceeded with as before, 4 depressing the gun to enable the breech-screw to be inserted. As soon as the breech is closed, the Gun Captain gives the signal to "*Run up*," by raising both arms vertically above his head. At this signal 10 raises the running up lever on the right side of the slide, which allows the gun to run up.

NOTE.—The tube will not be put into the vent by the Gun Layer until the gun is run up.

TO LAY AND FIRE.

No. 5 does not elevate.

The gun and slide cannot be raised off the pivot.

DRILL FOR 9.2-INCH, MARK IX, ON BARBETTE MOUNTING, MARK III.

GUN DETACHMENT.

The gun detachment consists of a Gun Captain, a Gun Layer, and nine other gun numbers. It falls in and is told off in the usual way.

TO PREPARE FOR ACTION.

Gun Group Commander.

Gun Captain.

".... *Group prepare for Action.*"

".... *Prepare for Action.*"

At the command "*Prepare for Action*" each number brings up his stores as follows:—

Gun Layer.—Sights, tubes, tube box, battery and key, test and firing, lanyard, rimer, percussion or electric lock, and wrench breech action, or wrench firing mechanism. For drill, a drill tube.

A pocket is supplied to hold the rimer, which the Gun Layer straps round his waist.

No. 2.—Traversing wheels, side arms, consisting of combined brush and sponge, and the rammer.

No. 3.—Oil can, Russian tallow, waste, McMahon spanner, and handle of control gear.

No. 4.—Elevating wheel and assists 2.

No. 5.—Assists the Gun Layer.

No. 6.—Assisted by 9, bucket, filled with water, and brush. For drill, drill cartridges in zinc cylinders.

No. 7.—Assisted by 8 and 10, transporting barrow and brush, handle of carrier, two selvagees, fuzes, two fuze keys, and a piece of chalk. For drill, a drill shell.

Group stores as for 9.2-inch on barbette mounting, Mark II, will be brought up by Nos. 6 and 7.

The Gun Layer receives the tubes from the shell store, fixes the sights in the gun, if used, taking care that the foresights fit correctly and that the deflection leaves of the hind sights work easily, sees that the bar and drum sights work correctly, attends to the auto-sight, seeing that the tide lever is set as ordered and that the error of the day screw is at zero, fixes the battery and key, test and firing, in position, and makes the necessary connections; connects up the electric lanyard, placing the percussion lanyard with tubes in a convenient position on the mounting; if percussion firing is used, gives the lanyard to No. 7, and having examined the lock, places it in the breech block.

No. 2, assisted by 4, will lay down his side arms in rear of the gun, rammer on the right. 2 puts on the traversing wheels and sees that the gear is oiled and in good order.

No. 3 removes breech and muzzle covers and muzzle tampon. He places his stores in a convenient position for use, puts on the handle of the control gear (if not already on), opens the breech, and sees that the gear is oiled and in good order, slightly lubricates the threads of the breech and breech screw with oil, and rubs the asbestos pad with Russian tallow.

The Gun Captain will now look through the bore and see that it is clear. No. 3 will then close the breech.

Nos. 4 and 5 put on elevating wheels and see that the gear is oiled and in good order, and elevate the gun until the breech rests on the wood block.

Nos. 6 and 9 place the bucket and brush near the cartridge depôt, loosen or remove bands from covers of cylinders, and at drill place the drill cartridges in cylinders outside the cartridge store or depôt.

Nos. 7, 8, and 10 place their stores handy for use, and a shell on the transporting barrow at the shell depôt. 7 puts on the handle of the carrier and sees that it works correctly, and gives a fuze key to 3.

The Gun Captain will now see that the buffers are completely filled with oil, and will then draw off half a pint from one of them. He sees that the gun and mounting is ready and fit in all respects for firing, and receives reports, from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, or stores.

No. 3 opens the breech by means of the control gear, and having performed his duties as above detailed, closes it again. When the breech is closed the Gun Layer passes a vent bit down the vent, fires a tube, sees that the lock is in good order, and rimes out the vent.

After each number has completed his work, as above, he takes post under cover as follows:—

Gun Captain.—Where he can best regain his position for superintending the working of the gun.

Gun Layer.—On the left of No. 4.

Nos. 2 and 4.—On the right of the gun.

Nos. 3 and 5.—On the left.

Nos. 2 and 3 being nearest the muzzle.

Nos. 6 and 9.—At the cartridge store or depôt.

Nos. 7, 8, and 10.—At the shell store or depôt.

TO LOAD.

4 and 5 elevate the gun into the loading position, if not already done. 3 seizes the handle of the control gear with his left hand and spins it round, thus opening the breech. 2 supplies himself with the rammer and stands ready to ram home.

7, 8, and 10 bring up the projectile on the barrow and upend it on to the loading tray of the carrier, afterwards sliding the barrow clear. 10 then seizes the handle of the carrier and raises the projectile in line with the bore, and, when high enough, places the pawl into the recess in the arc. (N.B.—The shell numbers change rounds at raising the shell as required.) Nos. 6 and 9 bring up the cartridge cylinders, with lids unscrewed to the last thread, and place them in a convenient position for Nos. 2 and 3, taking care that they are clear of the carrier in lowering.

When the shell is high enough, 2 will place the rammer against its base and 3 will remove the cap from the fuze. The shell will then be rammed home in one motion by 2, 6, and 8 on the right side, and 3, 7, and 9 on the left. As soon as the shell is clear of the loading tray, 3 will release the small cam on the carrier and allow the tray to slide down. The number at the carrier handle will then lower it down. 2 springs the rammer, and 7 and 8 lay it down.

3 loads the first half cartridge and 2 the second. 3 closes the breech by swinging round the handle of the control gear from rear to front.

The Gun Layer will insert a tube in the vent, lower the actuating lever of the lock until caught by the spring catch, connect up his tube wires, and mount to his sighting platform (unless ordered under cover), at the same time giving the order to depress to 4 and 5. The gun will then be brought down to the range shown on the dial, or such other range as may be ordered by the Gun Group Commander.

6 and 9 will remove the empty cylinders and replace them by full ones. 7, 8, and 10 will take their barrow to the shell store or dépôt and bring up another shell, which they will upend on to the loading tray of the carrier, which will then be raised until held by the pawl in the half way notch. They will then remove the barrow to the shell store or dépôt and place another projectile upon it.

Nos. 2 and 3 will man the traversing handles, 4 and 5 the elevating wheel.*

TO LAY AND FIRE.

The normal method of firing will be by electricity. In the event of failure of electric gear and percussion firing being necessitated, 7 will make ready and fire as follows:—

As soon as the gun is depressed into the firing position, 7 will step on to the carrier and be hoisted up by 8 and 10 high enough to enable him to hook the firing lanyard. He will then be lowered and will wait for the command to fire from the Gun Captain, which will be given when the Gun Layer signals that he is on the target.

The percussion tube is placed in the vent by the Gun Layer, and actuating lever lowered, as described above for electric tubes.

The normal means of laying the gun is either by automatic sights or bar and drum sights, and the gun sights would not be used unless these were out of action.

* When firing paper proof shot, made up in more than one portion, the gun will not be loaded or fired at angles of depression.

It is undesirable to put the tangent sights in the gun unless the carriage sights are out of action; and, when tangent sights are used, they will be removed before firing.

For further details of laying, *see* G.A. Drill, Vol. II, Sec. I.

As soon as the gun has been fired, 4 and 5 will elevate into the loading position without further word of command.

TO UNLOAD AT DRILL.

The gun is unloaded by the numbers who loaded it.

DRILL FOR 9-2-INCH B.L., MARK IX, ON BARBETTE, MARK IV, MOUNTING.

GUN DETACHMENT.

The gun detachment consists of a Gun Captain, Gun Layer, and nine other gun numbers. It falls in and is told off as usual.

TO PREPARE FOR ACTION.

<u>Gun Group Commander.</u>	<u>Gun Captain.</u>
"A Group Prepare for Action."	"A 1 Prepare for Action."

At "Prepare for Action" each number brings up his stores as follows:—

Gun Layer.—Sights, battery and key, test and firing, and electric lock and shoulder piece.

No. 2.—Tubes, tube box, side arms (combined brush and sponge and the rammer), lanyard, and percussion lock if used, rimer, wrench breech action, and wrench firing mechanism.

For drill, a drill tube (electric or percussion).

N.B.—A pocket is supplied to hold the rimer, which No. 2 straps round his waist.

No. 3.—Oil can, Russian tallow, waste, McMahon spanner and indicator, pressure spring.

No. 4 assists 2.

No. 5.—Assists 2 and 4.

Nos. 6 and 9.—At drill, zinc cylinders containing drill cartridges.

Nos. 7 and 8.—Bucket, filled with water, and brush, brush for shell, and a piece of chalk, also a selvagee.

No. 10.—Assists the Gun Layer and, for drill purposes, brings up a 7-foot handspike.

Group stores, as for guns on Mark II mountings, will be brought up by Nos. 6 and 7 of the guns for which they are intended. Those stores not in immediate use will be kept in the Group store recess in the upper shelter.

The Gun Layer fixes the foresights on the rocking bars, taking care that they are fitted correctly, and that the deflection leaves of the hindsights work easily. He fixes the automatic sight and telescope, and tests them. He fixes the battery and key, test and firing, on the mounting, and makes the necessary connections, places the tubes in a convenient position on the loading stage, and, having examined the electric lock, places it in the breech block. He then sees that the pointer for the traversing arc and safety bolt are let down.

Nos. 2 and 4 arrange side arms on the loading stage. No. 2 straps the tube box round his waist, receives the tubes from the shell store, places a convenient number of them in the tube box, and the remainder in the tube recess. If percussion firing is used, No. 2 fixes the percussion lock in the breech block, and places the lanyard in a convenient position on the loading stage.

No. 3 places the oil can, Russian tallow, and waste handy on the loading stage, and, assisted by 10, removes the breech and muzzle covers, and tampeon, placing them clear of the gun floor. He fixes the indicator pressure spring.

Nos. 6 and 9 place the drill cartridges in cylinders near the foot of the lifts.

Nos. 7 and 8 place the bucket and brush on the loading stage.

The other stores are placed on the gun floor, between the two lifts.

The Gun Captain now sees that the recoil gear is in working order, and that the indicator pressure spring reads 200; that the four screws, clamping cradle bridge, are removed for practice and placed in the rest holes provided for the purpose. (N.B.—Before this is done, it is of the utmost importance that the pressure is correct); that the gun and mounting are ready and fit in all respects for firing. He receives reports from the numbers responsible for any irregularity or deficiency in connection with the different parts of the gun, mounting, or the stores. He satisfies himself that the electric firing gear is correct.

No. 3 opens and closes the breech, 4 and 5 bringing the gun to the loading position. When open, the Gun Captain looks through the bore to see that it is clear.

Nos. 2 and 3 examine the breech-screw and its threads, and the breech and its threads respectively, rubbing the asbestos pad with Russian tallow, and lubricating the threads with a slight film of oil. When closed, No. 2 inserts a tube and sees that the lock is in good order. When the tube is inserted the Gun Captain puts in the firing plug and gives the word "Ready"; at this command the Gun Layer fires the tube, if electric, or No. 2 if percussion, firing is used.

No. 2 extracts the old tube and rimes out the vent.

N.B.—Before firing the tube, the Gun Captain will see that no one is in front of the gun, and that there is no charge in the bore.

No. 2 sees that the traversing, and No. 4 that the elevating gear is oiled and in good working order.

After each number has completed his work as above, he takes post on the gun as follows:—

Gun Captain.—Where he can best regain his position for superintending the working of the gun.

Gun Layer.—On the left of No. 10.

Nos. 2, 4, and 10 on the right of the gun.

Nos. 3 and 5 on the left of the gun.

Nos. 2 and 3 are next the gun; 4, 5, and 10 outside of them, all the numbers being clear of recoil.

Nos. 6 and 9 outside the cartridge store.

Nos. 7 and 8 at the head of the right and left ammunition lifts respectively.

To LOAD.	
<i>Gun Group Commander.</i>	<i>Gun Captain.</i>
"A Group."	"A 1."
".... Load."	".... Load."

The Gun Layer takes his place on the sighting step.

If the necessary ammunition is not on the upper shelter floor, No. 7 or 8 calls up the foot of the lift by one whistle. On being answered, he repeats the nature of ammunition required. When the trolley has been raised to the upper shelter floor, the N.C.O. in charge of the ammunition party at the foot of the lift sounds two blasts on the whistle of the speaking tube. Nos. 7 or 8, on hearing this signal, raises the trolley to the gun floor by throwing his lever over to "Raise," letting it return automatically.

N.B.—The shell would have been fuzeed in the shell store before placing on the trolley.

No. 7 or 8 then releases with his foot the catch securing the trolley to the lift, and, assisted by 10, pushes it round in rear of the breech.

Nos. 2 and 3, if necessary, traverse the gun to a convenient position for loading, Nos. 4 and 5 moving the loading stage in rear of the breech.

No. 3 opens the breech, and secures the trolley to the gun by the bolt on the former. No. 2 turns the carrier so that the point of the shell is towards the gun. The Gun Captain releases the catch holding the loading tray. Nos. 2, 3, 4, and 5 mount on the loading stage, and ram the projectile home.

The loading tray runs home with the shell. No. 3 releases and replaces it in the carrier, and unbolts the trolley from the gun. No. 2 turns the carrier to its travelling position on the trolley.

No. 7 (or 8) moves the trolley to the left of the gun, Nos. 2 and 3 extract the cartridges and place them in the chamber, removing the mill-board disc from the cartridges.

No. 3 then closes the breech, and No. 2 makes ready, and the Gun Captain gives the word "Ready," as soon as the tube is connected, if firing by electricity, or as soon as inserted and the lanyard fixed, if firing by percussion.

The trolley is removed to the lift from which it was brought by 7 or 8, and, when the ammunition for the next round arrives at the gun floor, is run up to the lift, to which it is secured by 7 or 8 engaging the catch with his foot; he then lowers it to the upper shelter floor as follows:—He presses down the stop with his foot, and throws the lever over to "Lower." When the lift comes to rest on the first floor, he will release the stop with his foot, and bring back the lever to the vertical position.

Ammunition is brought up alternately from the right and left lifts, unless one lift is disabled.*

N.B.—One trolley should always be on the gun floor, in case of the hydraulic gear being disabled, as it is required for loading. If an alternative system of loading from the derrick exists, the empty loading trolley may be lowered immediately after the gun is loaded.

* When firing paper proof shot, made up in more than one portion, the gun will not be loaded or fired at angles of depression.

TO LAY AND FIRE.

While the gun is being loaded, the Gun Layer will go to his sighting platform (the right, if automatic sights are being used), the Gun Captain making ready for electric firing, No. 2 for percussion.

Nos. 3 and 10 man the traversing handles, Nos. 4 and 5 the elevating wheels. The remaining numbers take post on the gun.

Electric or percussion firing, except as above stated, and that No. 2 fires by percussion, as laid down in G.A. Drill, Vol. II, Sec. I.

MISSFIRES.

See G.A. Drill, Vol. II, Sec. I.

AFTER FIRING.

As soon as the gun is fired, the Gun Captain, if firing by electricity, will remove the firing plug, and will note the range on the range indicator and bring the gun when loaded back to about that range.

No. 3 opens the breech, 4 and 5 bring the gun to the loading position.

No. 2 unhooks the lanyard if firing by percussion, extracts the old tube, and rimes out the vent. No. 3 supplies himself with combined brush and sponge, and replaces it.

TO CEASE FIRING.

As for 9.2-inch B.L., on Mark I mounting.

TO CEASE FIRING AND REPLACE STORES.

As above.

TO UNLOAD AT DRILL.

The gun is unloaded by the numbers who loaded it.

N.B.—Projectiles will not be lowered on the trolleys, but by means of the derrick and winch.

TO LOAD BY DERRICK.

This method is only used when the hydraulic lifts are not working. The trolley kept on the gun floor is used for the shell.

DRILL FOR 9.2-INCH B.L. MARK X, ON BARBETTE MOUNTING, MARK V.

The detachment consists of a Gun Captain, a Gun Layer, and ten other gun numbers.

It falls in and is told off in the usual manner.

POSITION UNDER COVER.

Gun Captain.—In rear of gun.
 Gun Layer.—On sighting step in rear of sight.
 No. 2.—On right of gun facing breech.
 No. 3.—On left of gun facing breech.
 No. 4.—In line with No. 2 and two short paces to his left.
 No. 5.—In line with No. 3 and two short paces to his right.
 Nos. 6 and 11.—Outside cartridge recess, or at the head of cartridge lift.
 Nos. 7 and 8.—At front hoist.
 Nos. 9 and 10.—At shell recess at head of shell lift.

TO PREPARE FOR ACTION.

<i>Gun Group Commander.</i>	<i>Gun Captain.</i>
“.... <i>Group prepare for Action.</i> ”	“.... <i>Prepare for Action.</i> ”

At “*Prepare for Action*” each number brings up his stores as follows:—

Gun Layer.—Electric firing battery (if not on the mounting) and box of spare parts and tools, screwdriver, sights, spare striker, and electric and percussion lock.

No. 2.—Tubes, wrenches for breech and firing mechanism and buffer, McMahon spanner, and rimer.

No. 3.—Oil can, Russian tallow, waste, percussion lanyard, and hoisting tackle.

No. 4.—Combined brush and sponge, rammer, bucket of water, and, at drill, cartridge and shell extractor.

No. 5.—Assists the Gun Layer.

Nos. 6 and 11.—Keys of cartridge recess, and, for drill, drill cartridges in zinc cylinders.

Nos. 9 and 10.—Brush for cleaning shell, 2 keys, fuze, universal, grease pot, hammer and chisel, shell barrow, and, for drill, a drill shell.

The Gun Captain will also bring up the key of the firing plug box.

The group stores will be brought up by Nos. 6 and 7. They consist of:—

Hammer.

Clinometer.

Broom.

Indicator pressure spring in box.

The stores having been brought up:—

The Gun Layer fixes the sights on the cradle and sees that they work and fit properly, and that the sight carrier is firmly attached to the mounting; when automatic sights are used he tests them, he attaches the electric firing battery to the mounting, if not already on, and makes the necessary connections; at night he sees that the leads for illuminating the sights are properly connected up, and tests and adjusts the lamp for the sights if necessary, he places the lock in position.

No. 2 places the tubes and rimer in a convenient position for use, his other stores he will place on the mounting, clear of the working of the gun.

No. 4 will place the combined brush and sponge, and the rammer, in a convenient position for use, the sponge bucket by the right side shield. At drill he places the cartridge and shell extractors by the right side of the rammer.

No. 3 will place the oil can, Russian tallow, and waste in a convenient position on the mounting for use, place the percussion lanyard under his belt, hook the hoisting tackle to the loading derrick and overhaul it, and remove the tampon from the muzzle.

No. 5 will assist the Gun Layer.

Nos. 6 and 11 go to the cartridge lift or recess, and prepare to issue cartridges to 3 and 5.

Nos. 7 and 8 will go to the front shell hoist, and as soon as they find out the nature of the projectile to be used, proceed to fill the six shell trolleys; No. 7 attending to the control lever of hoist, and No. 8 to the trolleys.

Nos. 9 and 10 go to the shell lift or recess and supply 7 and 8 with projectiles, cleaning them first, if necessary, and removing the grumets from the driving bands.

The Gun Captain now sees that the buffer is properly connected up and not leaking at the gland, that it contains the correct amount of oil and air pressure, that the accumulator is filled with liquid, and that the capsquares are properly secured. He receives reports from the numbers responsible concerning any irregularity or deficiency of any article connected with the gun, mounting, or stores.

The Gun Layer sees that the elevating and traversing gear is in good working order.

No. 2 opens the breech; he then passes the vent bit down the vent and inserts an electric tube.

No. 3 examines the threads of breech and breech screw, sees that they are free from grit or burrs, lubricates them slightly with oil, sees that the asbestos pad is in good order, and smears it over with Russian tallow.

The Gun Captain now looks through the bore and sees that it is clear.

No. 2 closes the breech, and the Gun Layer tests the circuit by firing a tube.

TO LOAD.

Gun Group Commander.

".... Group."
".... Load."

Gun Captain.

".... 1."
".... Load."

No. 2 opens the breech, places an electric tube in the vent (for percussion firing No. 2 places tube in vent and cocks lock before closing breech), he then attends to control lever of rear shell hoist.

No. 3 swings loading tray round in rear of breech.

No. 8 runs round trolley with shell over rear hoist, taking care that the clip on shell pit shield rests on recess in trolley.

The Gun Captain will now give No. 2 the signal to raise the shell; as soon as shell is level with loading tray, No. 2 halts by bringing the lever to centre.

No. 2 must be very careful not to raise the shell too fast, or the hoist tray will come violently against the loading tray and damage the ram and the hoist.

No. 4 then supplies himself with the rammer, places the head against the base of the shell, and, assisted by 3 and 5, rams home. When the shell is home, No. 5 drops off the rammer stave and 4 withdraws the rammer and replaces it.

No. 2 now lowers shell hoist.

No. 8 removes empty trolley.

Nos. 6 and 11 will bring up cartridges in cylinders and place the cylinders on the staging in rear of the mounting.

Nos. 3 and 5 take out the cartridges, 3 the first, he then places it in the chamber, swings the loading tray clear. No. 5 then places in the second cartridge, steps clear, and No. 2 closes the breech.

Nos. 9 and 10 supply 7 and 8 with projectiles; 7 and 8 keep the trolleys filled, and will see that the bands for keeping projectiles in the trolleys are properly secured before lowering.*

TO LAY AND FIRE.

The Gun Layer adjusts his sights (if not automatic) to the range ordered by the Gun Group Commander, he keeps his gun laid upon the target, giving elevation and training by means of the hand wheels, and waits for the order to fire.

When changing from one target to another, No. 9 will, if necessary, man the traversing wheel below and assist the Gun Layer to traverse the gun.

When firing by Position Finder, Case III, the Gun Captain and Gun Layer will put on the elevation and training themselves by means of the gear below.

TO CEASE FIRING.

With electric firing No. 2 opens the breech.

With percussion firing No. 3 unhooks the lanyard, 2 opens the breech, and 3 releases the striker.

DRILL FOR 9.2-INCH B.L. GUN ON DISAPPEARING MOUNTING, MARK I.

The drill is the same as with Barbette, Mark II, mounting, with the following exceptions:—

TO PREPARE FOR ACTION.

No. 3 brings up indicator, pressure, spring in addition to other stores.

5 brings up hoisting tackle and handle of lowering pump.

Additional stores:—One reservoir compressed air is allowed per mounting in addition.

2 and 4 place the loading trays beside the rammer next to the gun; for mountings fitted with loading gear, the loading trays are not required.

2 and 3 disconnect the holding-down clips on their own sides.

5 rigs the hoisting tackle, and with mountings fitted with loading gear sees that the gear is well oiled and ready for use.

* When firing paper proof shot, made up in more than one portion, the gun will not be loaded or fired at angles of depression.

When loading gear is fitted 7 and 8 bring up a projectile on the barrow, and assisted by 9 and 10 raise it with the hoisting tackle on to the loading tray; 10 hooks the lower block, guides and steadies the projectile in raising, 7, 8, and 9 man the fall.

The detachment will remove the covering plates.

The Gun Captain will see that—

The automatic cut off gear is in adjustment and in good order.
(To be noted when the gun is in the firing position.)

The holding-down clips are disconnected.

The roller path is clean.

A sand bag is placed in front of the muzzle if a tube with brass ball is fired when the gun is down.

TO LOAD.

2 and 3 open the breech; when loading gear is fitted 3 then stands clear.

7 and 8 bring up a projectile on the barrow to the left rear of the breech, 7 hooks the lower block, and the fall is manned by 7, 8 and 9; 5 steadies the shell, which is hoisted chock-a-block.

10 supplies the rear portion of the loading tray to 3, who inserts it.

The projectile is pushed on to the loading tray by 2, 3, 5, and 10, the numbers on the fall easing off.

2 unhooks the lower block, 3 uncaps the fuze, 5 overhauls the hoisting tackle and holds it clear. When loading gear is fitted, 3 uncaps the fuze, 5 releases the catch retaining loading gear and swings the shell into the breech, being careful to adjust the height of the tray by means of the hand wheel, to prevent it from fouling the threads of the breech. 4 supplies the combined rammer and sponge, placing it against the shell; 2, 4 and 10 on the right, 3, 7 and 8 on the left, ram home in one motion, 2 and 3 being near the breech, the other numbers at the end of the stave; when home, 2 and 3 sponge out by giving the combined rammer and sponge two half turns to the left, withdraw it hand over hand with a corkscrew motion, and hand it to 4, who thoroughly saturates the sponge head with water, reverses the stave, and stands in rear of the breech to ram home the cartridges with the stave end if required. When loading gear is fitted 3 stands clear and 5 swings back the loading tray to its original position.

6 and 9 supply cartridges in cylinders with lids unscrewed.

2 and 3 insert cartridges alternately, 2 putting in the first.

3 removes shalloon patch from base of last cartridge, 2 and 3 push home the cartridges using the rammer if necessary, when 4 would assist. 2 withdraws rear portion of loading tray, hands it to 10 who lays it down. 3 (and 2 and 8 with U.C. guns) closes the breech and the Gun Layer inserts a tube.

As soon as the loading is completed, 7 and 8 bring up another projectile which is hoisted by 7, 8 and 9, and secured by a turn round the cleat on the lower block; or, if loading gear is fitted, is hoisted on to the loading tray as described under preparation for action.*

* When firing paper proof shot, made up in more than one portion, the gun will not be loaded or fired at angles of depression.

INSTRUCTIONS AS TO RUNNING UP, LAYING, AND FIRING.

Disappearing mountings are now fitted with shield sights, and as it is desirable to expose the Gun Layer for as short a time as possible, the normal method of laying will be by Case II, using shield sights and electric firing gear. Should this gear break down, Case II may still be employed, using gun sights, and the Gun Layer firing from the rear sighting step by percussion.

2 and 3 traverse, assisted by 9 and 10 if required. 4 and 5 elevate.

In all cases the guns will be run up on the word of command from their Gun Captains, "*Stand Clear—Run Up.*" This word will be given on receipt of a signal or order from the Gun Group Commander, but detachments will take posts to lay as soon as the guns are loaded, unless specially ordered under cover.

The Gun Group Commander will give his order or signal to run up under the different orders of fire, as follows:—

At Single Gun Fire, if by order or signal from the Battery Commander, as soon as this order or signal is received.

At Single Gun Fire in succession from a flank, and also at Group Fire and Independent Fire, the Gun Group Commander's order "*Lay*" for the final elevation will be equivalent to an order to run up.

RUNNING UP, LAYING, AND FIRING.

Case I.

As soon as the gun is loaded, the Gun Layer will set his tangent sight at the range and deflection ordered by the Gun Group Commander, take post at the manhole, and, directing the traversing numbers, either by signal or word of command, as may be most convenient, traverse the gun roughly on the target if stationary, or well ahead of it if moving, by means of the shield sights.

The Gun Captain will keep the Quadrant Elevation Indicator set at about 100 yards less than the range called out by the Gun Group Commander.

On the final range being given, the Gun Captain will order "*A 1 Lay,*" followed, if so required by the order of fire, by "*Stand Clear—Run Up.*"

The Gun Layer will repeat the elevation and deflection ordered, and will move to the top of the shield by the shortest way; and, as soon as the gun has risen above the top of the shield, will adjust his tangent sight to that range and deflection, and attach his firing lanyard if firing by percussion, and fold down the cam lever.

No. 5 or 10 will press down the lever of the raising valve as far as it will go, and take his hand away, allowing the gun to run up until the pointer on the elevator coincides with the arrowhead on the crosshead of the ram. He will then close the raising valve completely, by raising the lever as far as it will go.

When the gun is fully up, the Gun Layer will step on to the spring sighting step, and complete his laying for elevation from there, directing the elevating numbers by word of command, and being careful to see that the last motion is one of elevation.

On the command "*A 1 Commence Firing*" from the Gun Group Commander, the Gun Layer will seize the firing lanyard, if firing by percussion, move to the rear sighting step, and complete his laying

for line from there. The Gun Captain, as soon as he sees the Gun Layer and other numbers clear of recoil, will give the order "*Fire A 1*," if firing by percussion, and if by electricity, will first put in his firing plug. On this command, the Gun Layer will fire the gun, either by pulling the lanyard or pressing in the knob of the key, test, and firing according as percussion or electric firing is being used.

Case II.

Shield Sights and Electric Firing.—As soon as the gun is loaded, the Gun Layer will fold down the cam lever and take post at the manhole, set his deflection leaf to the deflection ordered by the Gun Group Commander, and continue to follow the target, keeping somewhat ahead of it, and communicating with the traversing numbers either by signal or word of command, as may be most convenient. The Gun Captain will keep his gun laid by the Quadrant Elevation Indicator at about 100 yards less than the range given by the Gun Group Commander or shown on the Group dial.

On the final range being given, the Gun Captain will order "*A 1 Lay*," followed, if so required by the order of fire, by "*Stand Clear—Run Up*." He will himself repeat the elevation ordered by the Gun Group Commander, and will give it to the gun, not waiting until the gun is up, but being careful to check it when the gun is completely up.

The Gun Layer will repeat the deflection ordered by the Gun Group Commander, and will lay his gun in the usual manner by the shield sights.

No. 5 or 10 will attend to the raising valve, as ordered under Case I.

On the Command "*A Group*" or "*A 1 Commence Firing*" from the Gun Group Commander, the Gun Captain, seeing all the numbers clear of recoil and the Gun Layer ready, will put in the firing plug and give the order "*Fire A 1*." The Gun Layer will stop the traversing, and as soon as the target cuts his line of sight, will fire the gun by turning the knob of the firing key and pressing it in.

Percussion Firing—The gun sights are used and the gun is laid and fired from the rear sighting step. The Gun Layer sets his tangent sight and deflection leaf as soon as the gun is loaded, he then takes post at the manhole and keeps ahead of the target until the final lay is given. On receiving the final lay, he mounts and sets his deflection leaf to the exact deflection ordered, and attaches his lanyard and folds down the cam lever as described under Case I. He then moves to the rear sighting step, lays for line, and fires from there as usual.

The drill for the other numbers is similar to that for electric firing, except that there is no gun plug in use.

Case III.

The drill is similar to Case III for other mountings. The Gun Captain will order "*Stand Clear—Run Up*" immediately after his final lay as required by the order of fire. The elevation and training can as a rule be given while the gun is running up, but the Gun Captain will be careful to check the elevation when the gun stops, as it sometimes shifts when the gun comes to rest.

Note.—Guns on H.P. mountings will not be run up with more than five degrees depression.

TO UNLOAD AT DRILL.

As soon as the gun has been fired the Gun Captain gives signal or order "*Run back.*" 5 ships the handle of lowering pump, and assisted by 2, 3, and 4, runs back. If the gun does not fall at each stroke of the pump, tackles must be used to assist. On no account are jacks to be used to force the gun down.

As soon as the gun is down the Gun Captain gives the signal or order "*Halt.*" 5 unships the handle of lowering pump and replaces it. The gun is then unloaded similarly to the gun on barbette mounting, Mark II.

TO CEASE FIRING AND REPLACE STORES.

The Gun Captain sees that the holding-down clips or bolts have been connected, that the gun does not rest on the buffers, and that the raising lever is secured by chain and padlock.

 DRILL FOR 9.2-INCH B.L. ON DISAPPEARING MOUNTING
MARK II.

The drill is the same as that for the 9.2-inch B.L. on Mark I mounting, with the following exceptions:—

TO PREPARE FOR ACTION.

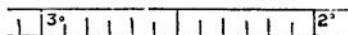
The detail relative to hoisting tackle brought up by 5, and slings or selvagees brought up by 7, is omitted.

5 sees that the lifting gear is oiled and in working order.

INSTRUCTION FOR USING LARGE CLINOMETER.

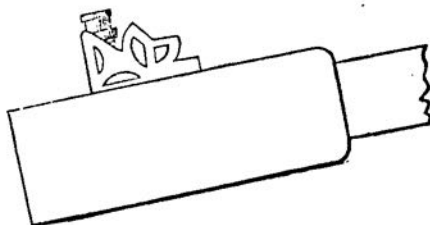
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into twelve parts; each small division therefore represents angles of 5 minutes.

The scale is read from right to left, thus—



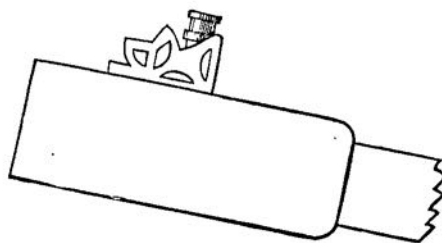
the reading opposite the arrow would indicate an angle of $2^\circ 25'$.

To lay a gun at any angle up to 45° .—Unscrew the drum, until the \uparrow points to the elevation required, place the clinometer, thus—

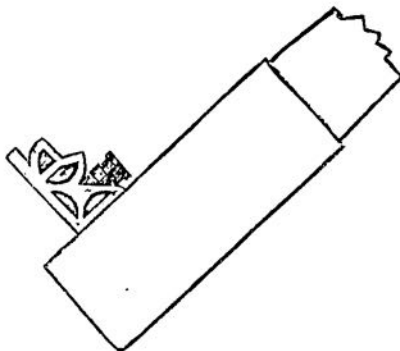


on the plane surface cut on the breech, and elevate the piece until the bubble of the spirit-level is in the centre of the tube.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



For angles of elevation greater than 45° .—Subtract the angle of elevation required from 90° , unscrew the drum to this reading; thus, for 60° , unscrew the drum to 30° , and place the instrument on the breech of the gun and elevate until the bubble is in the centre of its run, thus—



Preservation and Adjustment of the Instrument.—In order to preserve the clinometer in efficient working order it is necessary to keep the working parts free from grit and dust as far as possible. As excess of oil is apt to cause the adhesion of grit, only sufficient is to be applied to make the screw work smoothly, and to keep the steel parts from rusting.

On no account should the instrument be taken to pieces, as it requires special tools to put it together again.

Instruments are issued in correct adjustment, and with due care will remain correct for many years.

To ascertain if the instrument is in adjustment:—

- (a) Carefully clean the plane surface cut on a gun for use with the clinometer.
- (b) Turn the drum to zero.
- (c) Place the instrument on the plane surface (drum towards breech), and elevate or depress the gun till the bubble is in the centre of its run.
- (d) Turn the clinometer end for end.
- (e) Should the bubble not return to the centre, the instrument is out of adjustment.
- (f) As the amount of the error will generally be small it is advisable to add or subtract the error, as the case may be, rather than correct the adjustment.
- (g) To ascertain the error after complying with (d) (drum towards muzzle), turn the drum until the bubble is again in the centre of its run; *one half* the reading on the drum is the index error.
- (h) If the reading falls on the *black* markings on the drum *add half* the amount when setting the clinometer for any required *elevation*.
- (i) If the reading falls on the *red* markings on the drum, *subtract half* for any required *elevation*.

If it is required to adjust the clinometer to have *no* index error set the drum to the ascertained index error (keeping the drum end towards muzzle), and bring the bubble to the centre of its run by manipulating the capstan-headed nuts (using a tempered steel wire just fitting the holes in the nuts). Then placing the drum at zero, elevate or depress the gun till the bubble is in the centre.

Reversing the instrument end for end should not alter the central position of the bubble; should it do so, proceed as before until there is no change.

ALTERATIONS.

Para. of List of Changes.	• Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

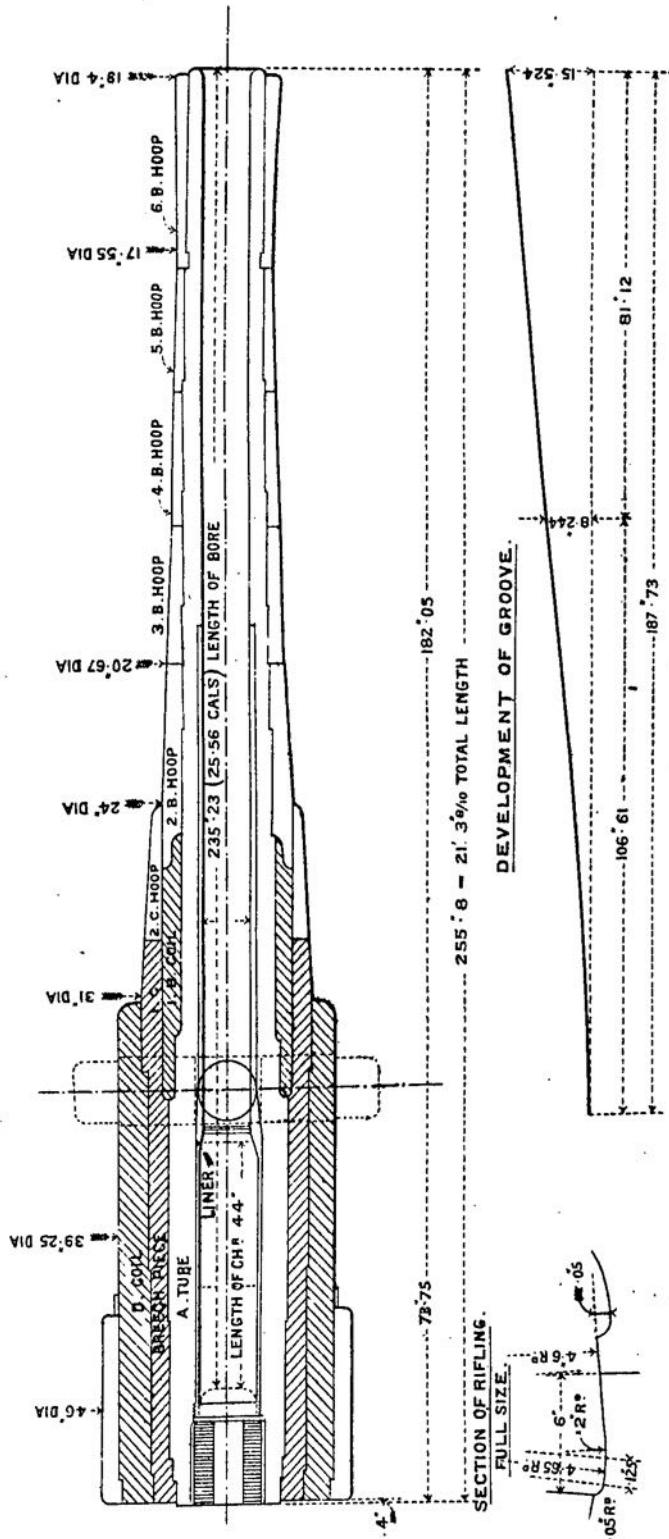
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PRINTERS IN ORDINARY TO HIS MAJESTY.

(Wt. 1616 2000 5 | 02 9784) $\frac{P. 01}{259}$

ORDNANCE, B. L., 9.2 INCH, C. MARK I.

STEEL & WROUGHT IRON 22 TONS.

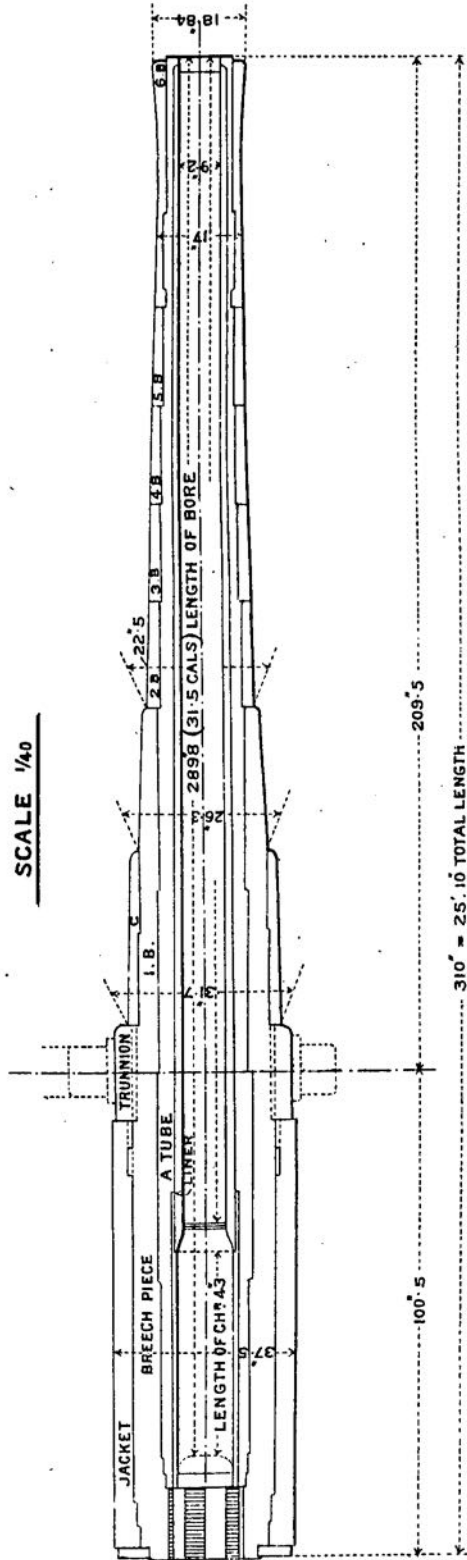
SCALE 1/35.



ORDNANCE, B. L., 9.2 INCH, MARK IV. A.

STEEL 23 TON.

SCALE 1/40



SECTION OF GROOVE.

FULL SIZE.

37 GROOVES.

243.4 TOTAL LENGTH OF RIFLING.

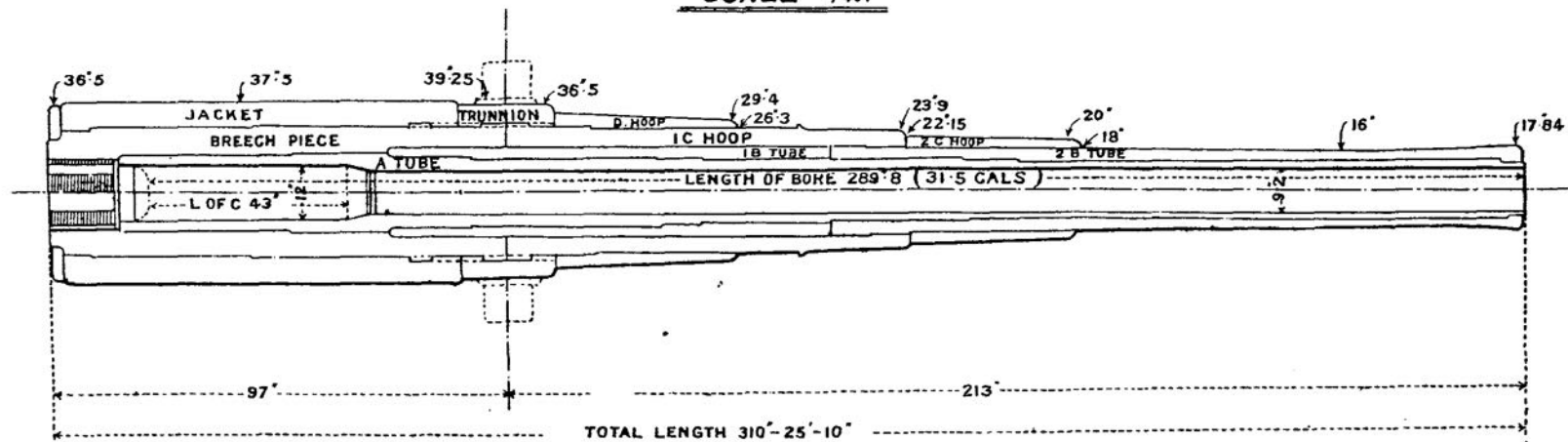
Rifling on uniformly increasing twist from 1 turn in 60 calibres at Breech to 1 turn in 30 calibres at muzzle.

1227 S. 1804

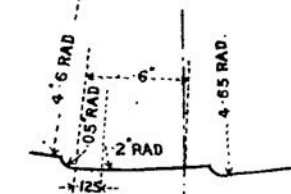
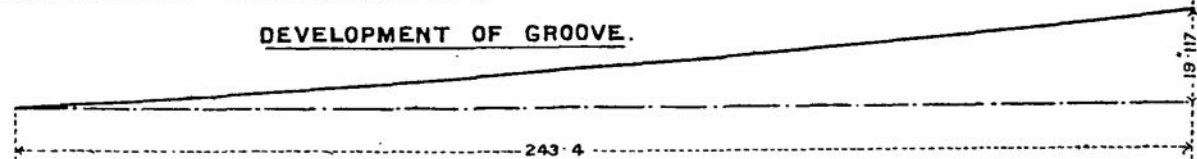
ORDNANCE, B. L. 9·2-INCH, MARK VI.

STEEL; 22 TON.

SCALE 1/40.



DEVELOPMENT OF GROOVE.



SECTION OF GROOVE.

FULL SIZE.

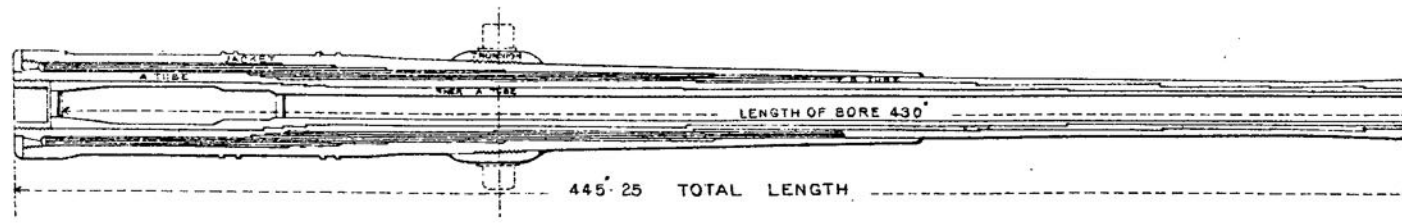
Nº OF GROOVES 37.

Rifling an uniformly increasing twist from 1 turn in 6 Calibres at Breech to 1 turn in 30 Calibres at Muzzle.

ORDNANCE, B.L., 9.2 INCH, (WIRE). MARK IX.

27 TON.

SCALE $\frac{1}{80}$.

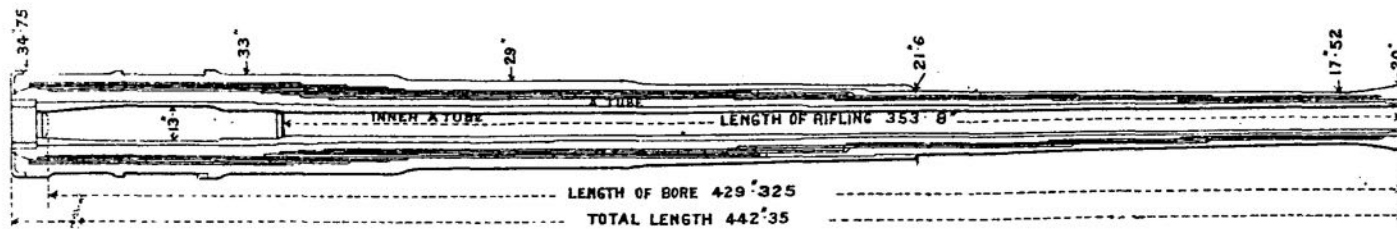


1237 S. 1801.

ORDNANCE, B. L., 9.2 IN. (WIRE,) MARK X.

STEEL, 28 TON.

SCALE 1/60.



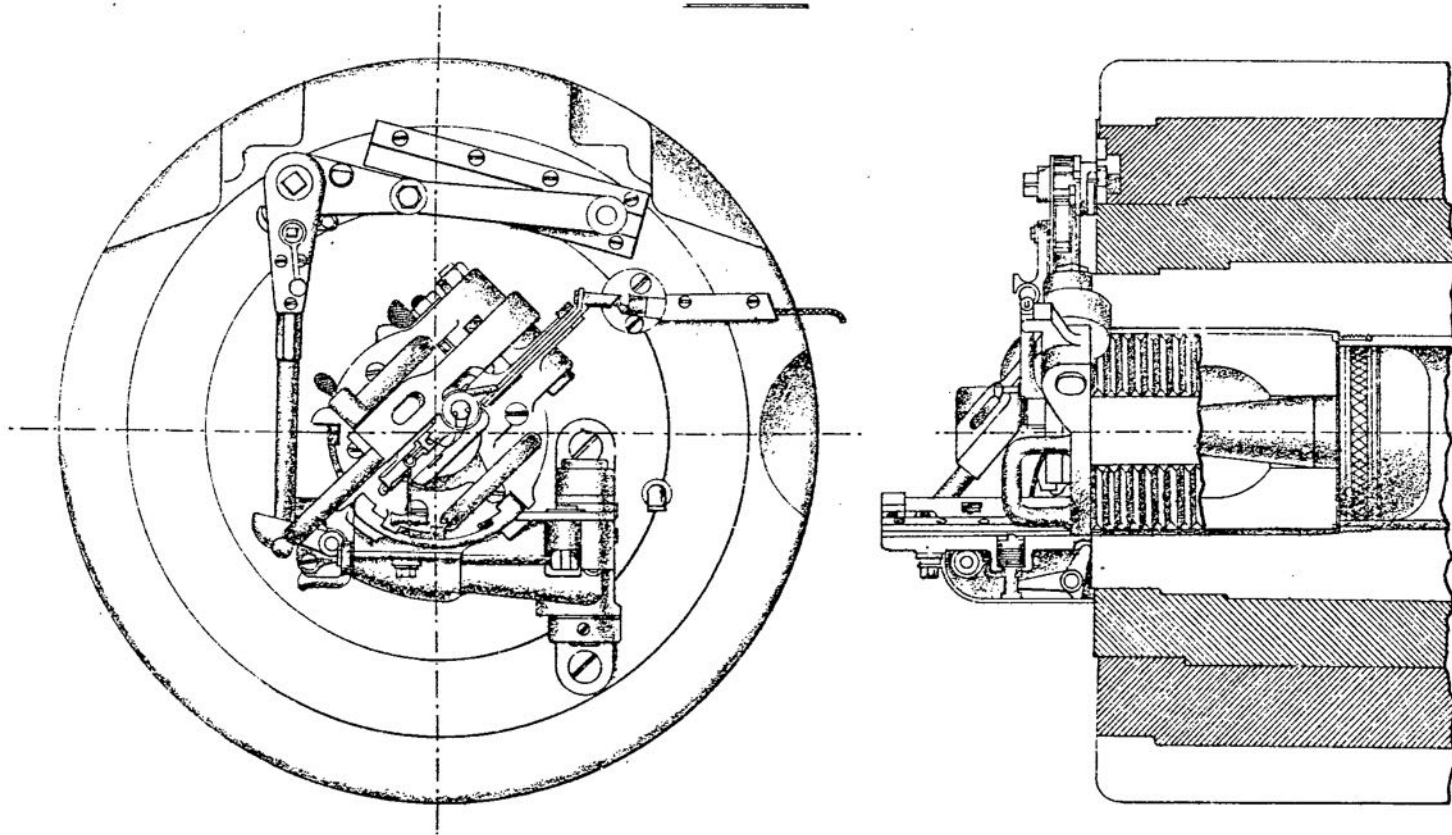
E. Weiler & Grahams, Ltd. Litho. London.

Plate IV

ORDNANCE, B.L., 9·2 INCH, U.C. MARK I.

BREECH CLOSING MECHANISM.

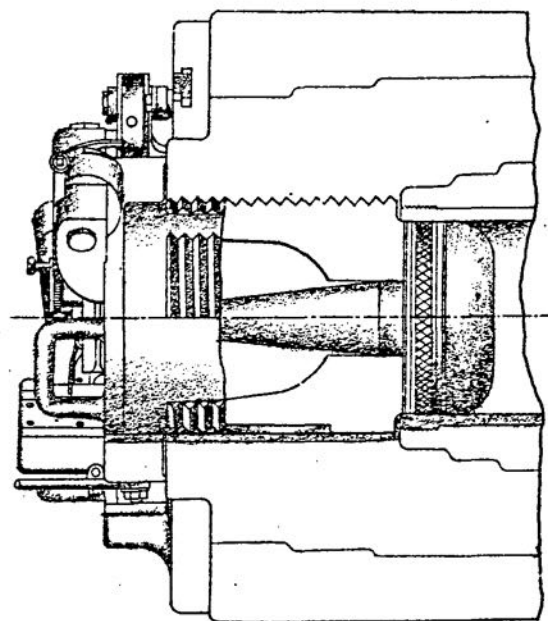
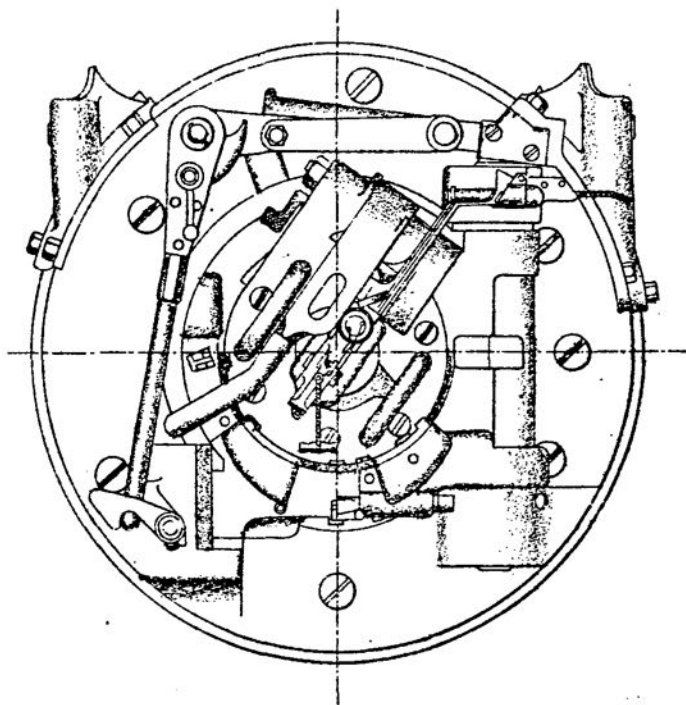
SCALE $\frac{1}{12}$.



ORDNANCE, B. L., 9.2 INCH, U.C. MARK IVA.

BREECH CLOSING MECHANISM.

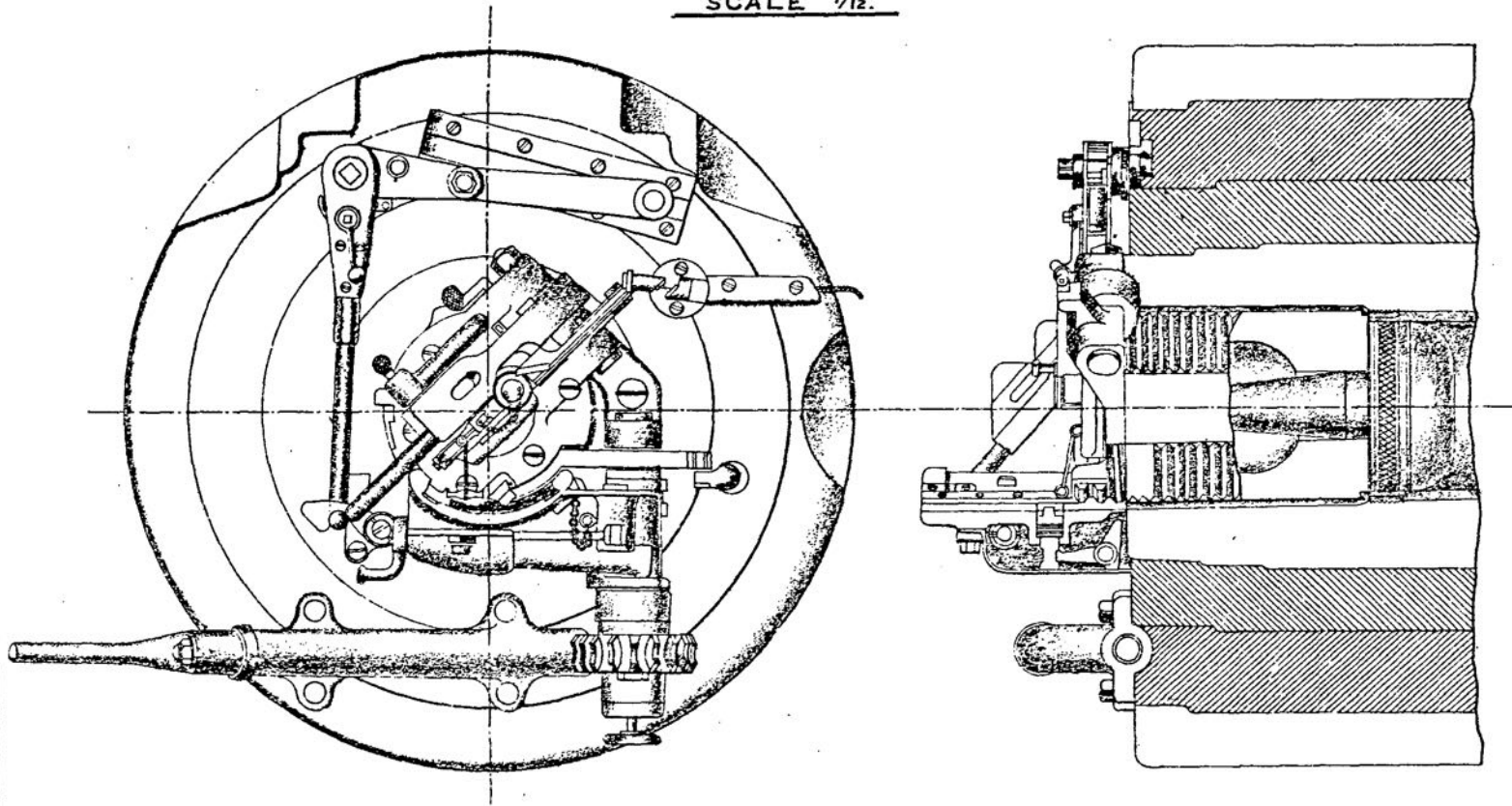
SCALE 1/12.



ORDNANCE, B. L., 9·2-INCH, C. MARK I.

BREECH CLOSING MECHANISM.

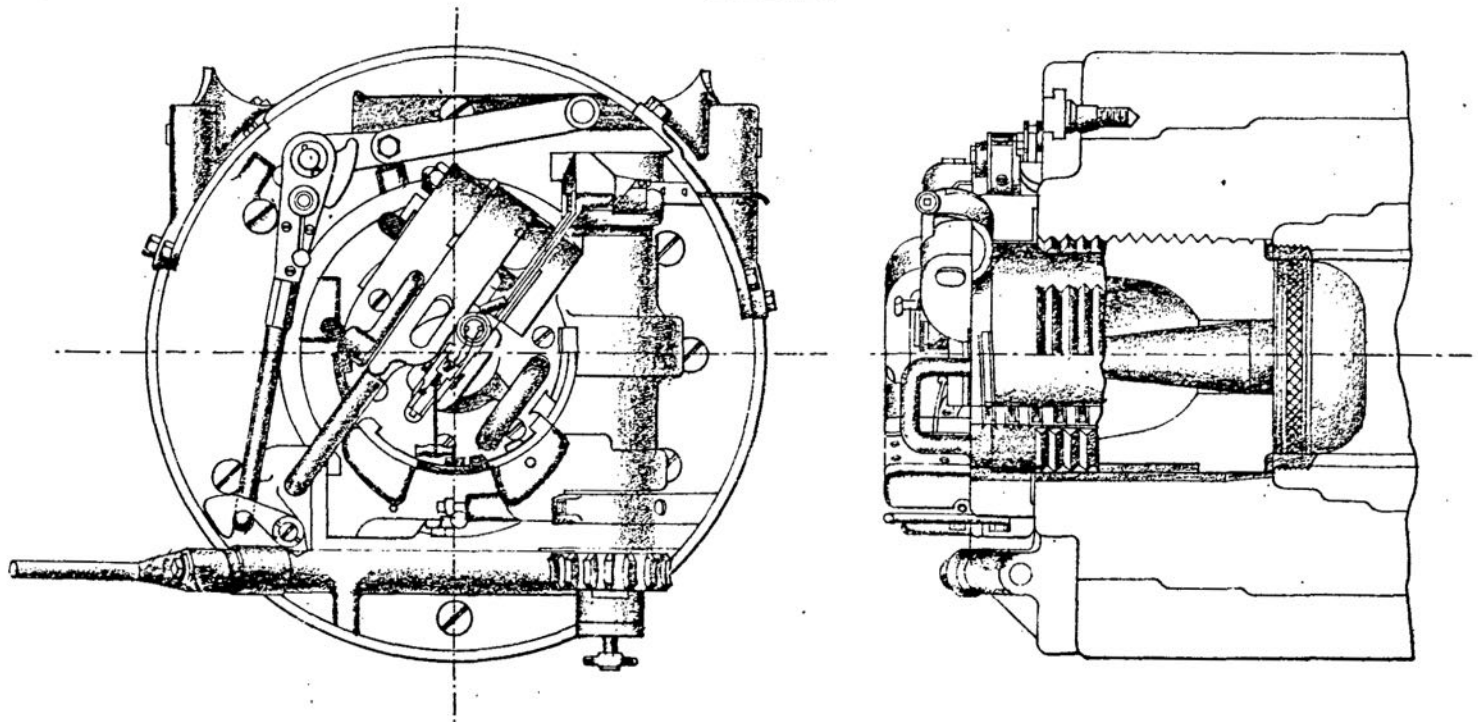
SCALE 1/12.



ORDNANCE, B. L., 9·2-INCH, C. MARK IV. A.

BREECH CLOSING MECHANISM.

SCALE $\frac{1}{12}$

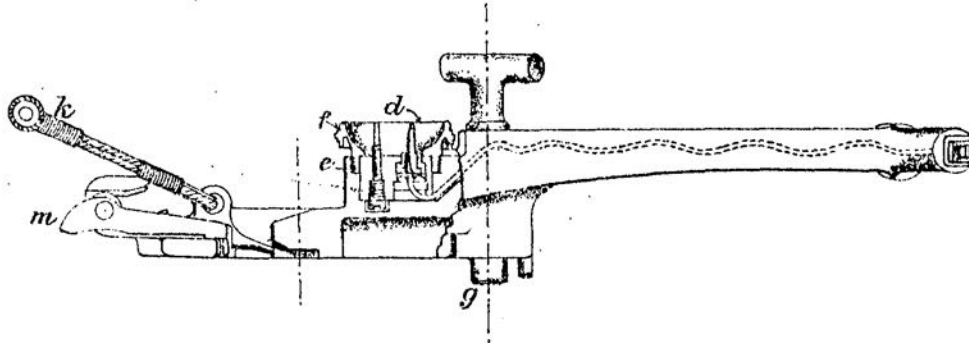
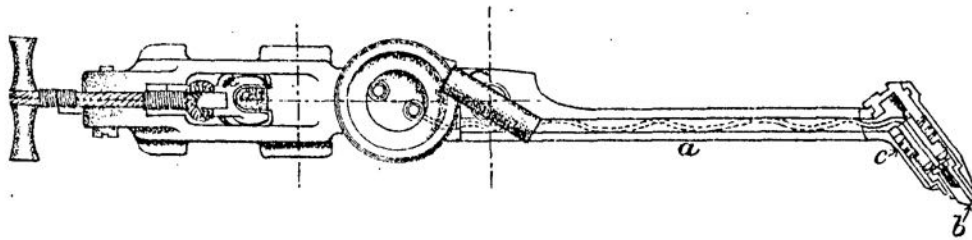


237 2.180.

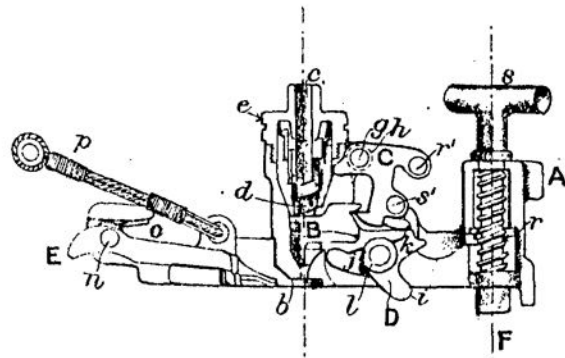
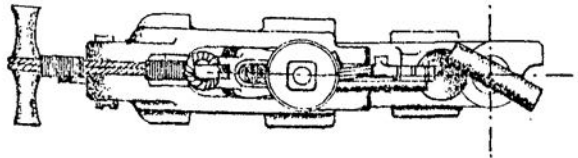
L. Weller & Grahams, Ltd Litho. London.

Plate VIII.

LOCK, ELECTRIC
"B"

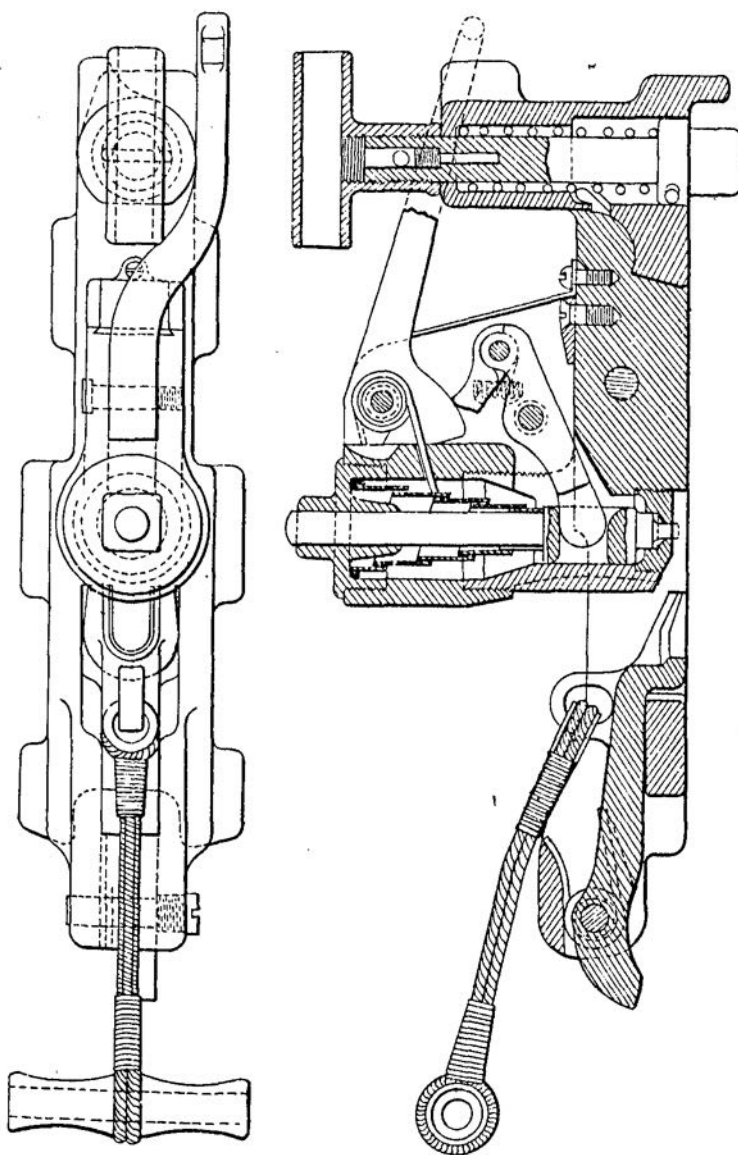


LOOK. PERCUSSION
"D"



ORDNANCE, B.L. LOCK. PERCUSSION J. (MARK I)

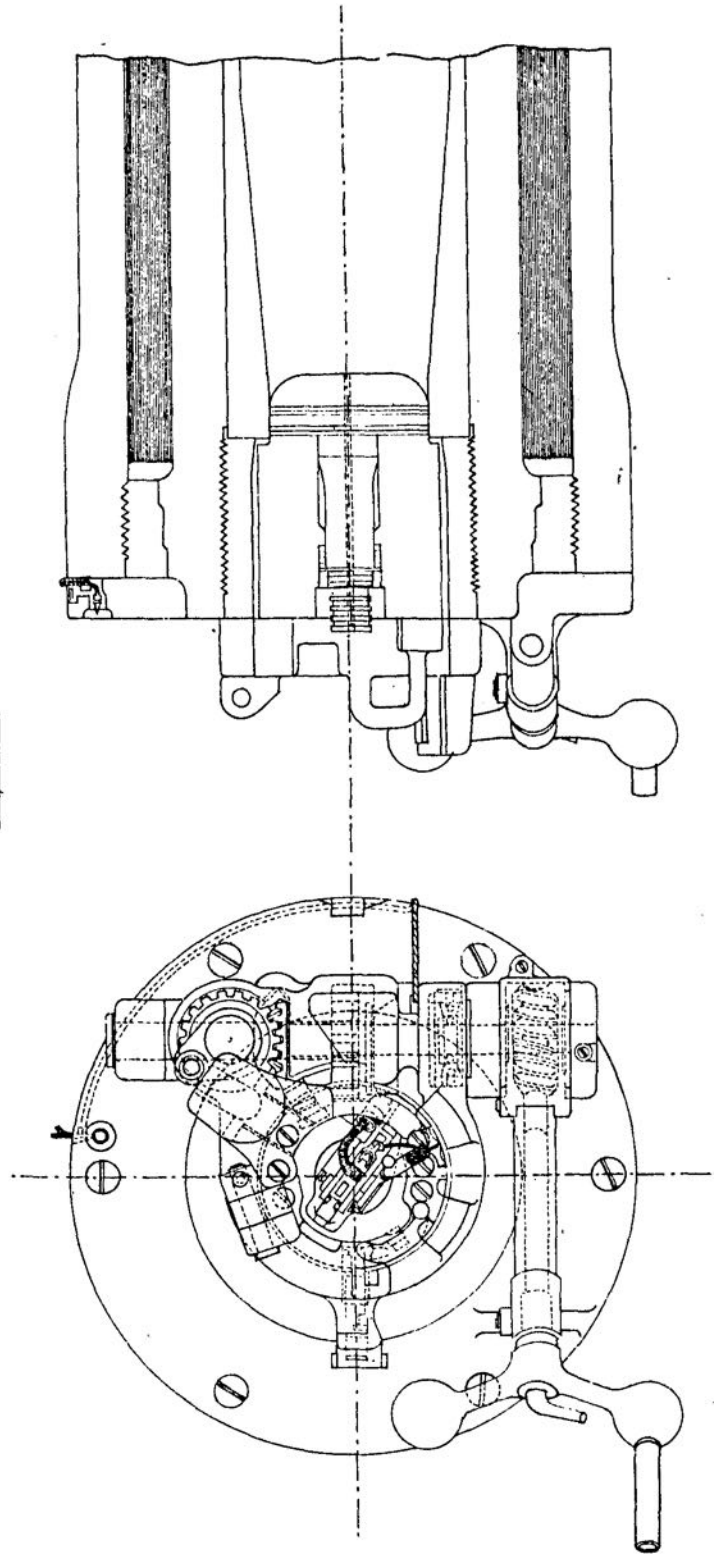
SCALE $\frac{1}{2}$.



ORDNANCE, B. L. 9.2 INCH, (WIRE.) MARK IX.

GENERAL ARRANGEMENT OF BREECH MECHANISM

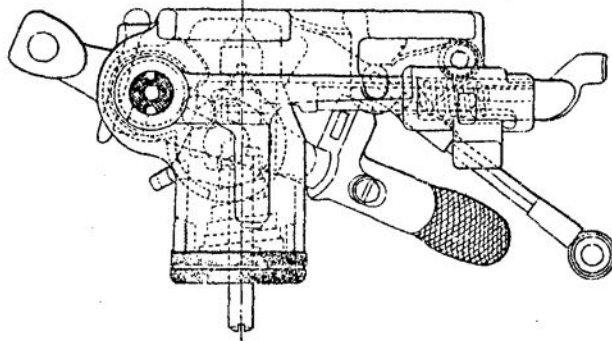
SCALE $\frac{1}{16}$.



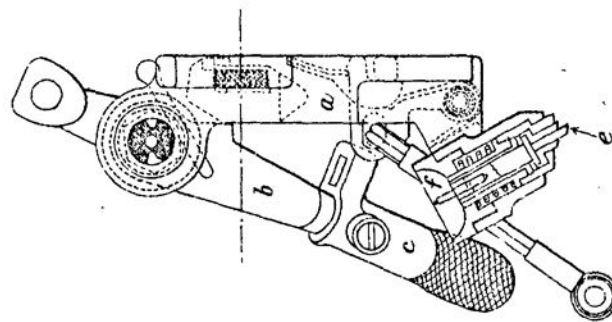
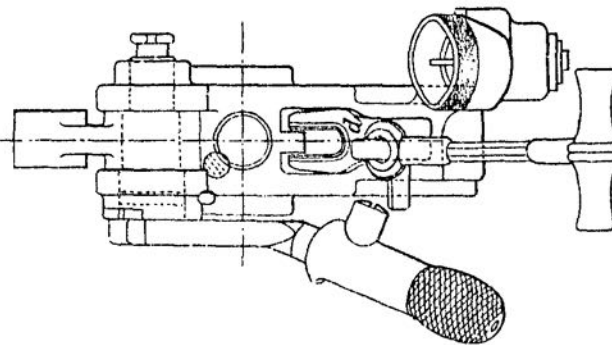
ORDNANCE, B. L., 9.2 INCH (WIRE) MARK IX.

SCALE $\frac{1}{3}$.

LOCK PERCUSSION.

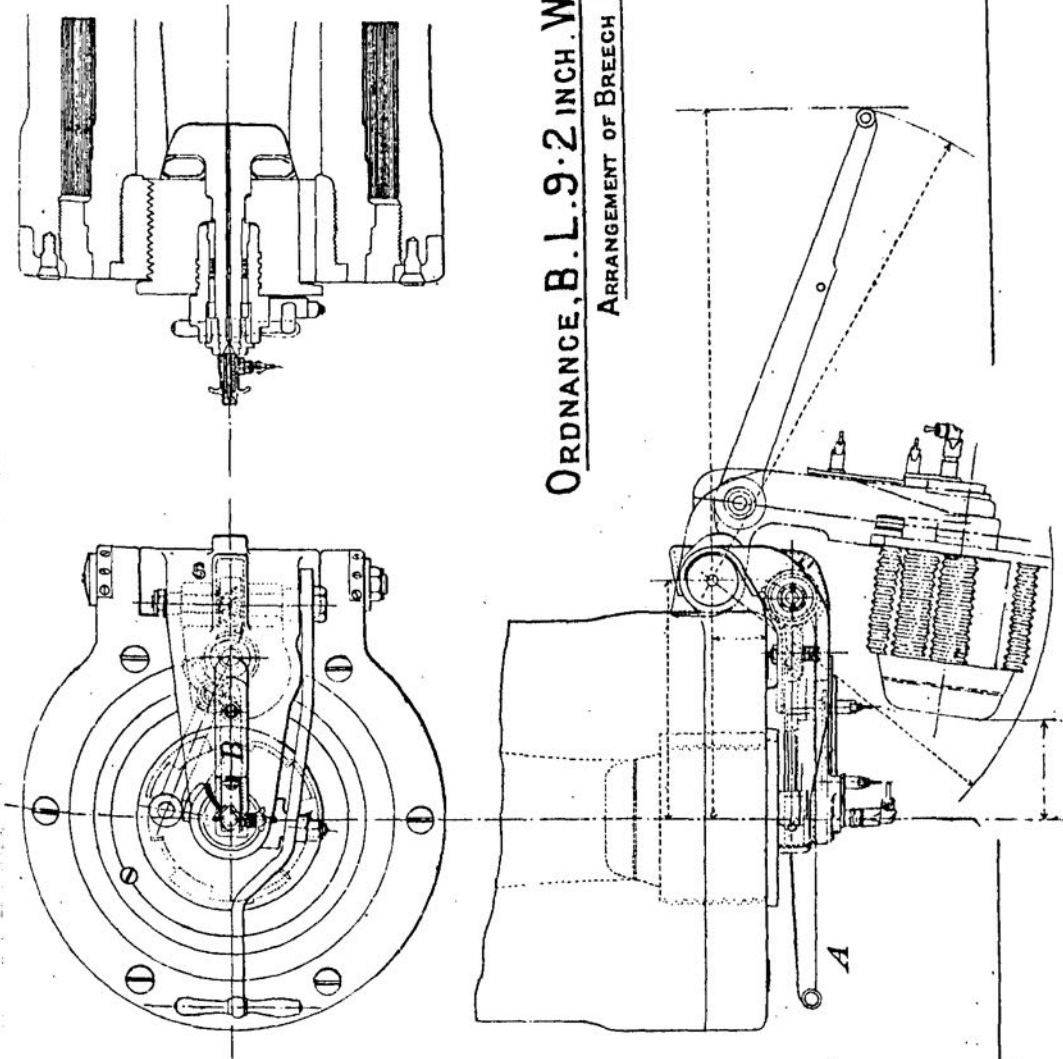


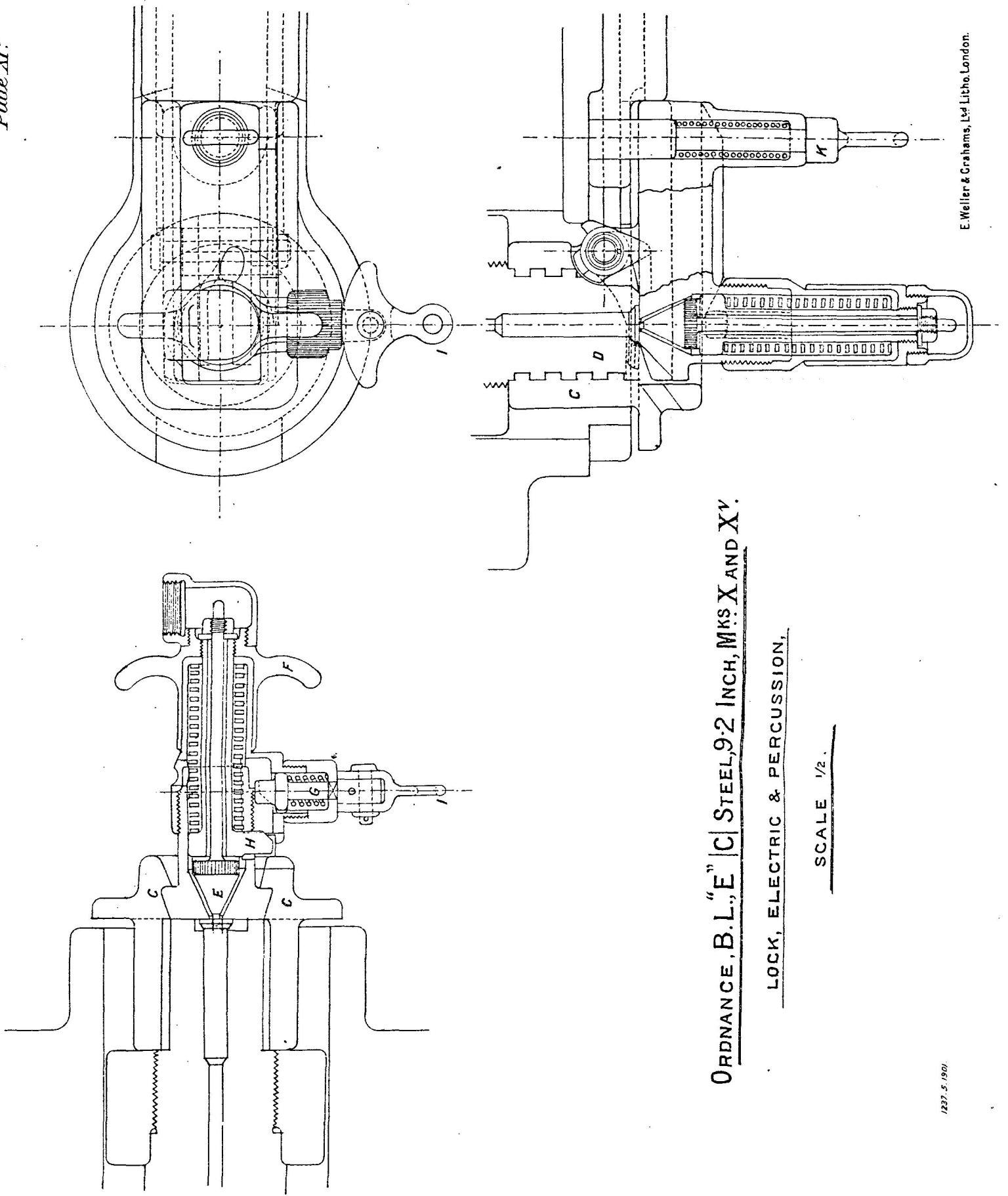
LOCK ELECTRIC.



1227. S. 1901

ORDNANCE, B. L. 9.2 INCH. WIRE, MARKS X & X^{VC}
ARRANGEMENT OF BREECH MECHANISM.





ORDNANCE, B. L., "E" C STEEL, 9.2 INCH, MKS X AND XV.

LOCK, ELECTRIC & PERCUSSION.

SCALE 1/2.

BOX, OBTURATING PADS AND DISCS. B.L. 9.2 INCH. MARKS I.

WOOD WITH GUN-METAL BOLT & FLY NUTS TO HOLD 3 PADS

SCALE $\frac{1}{4}$.

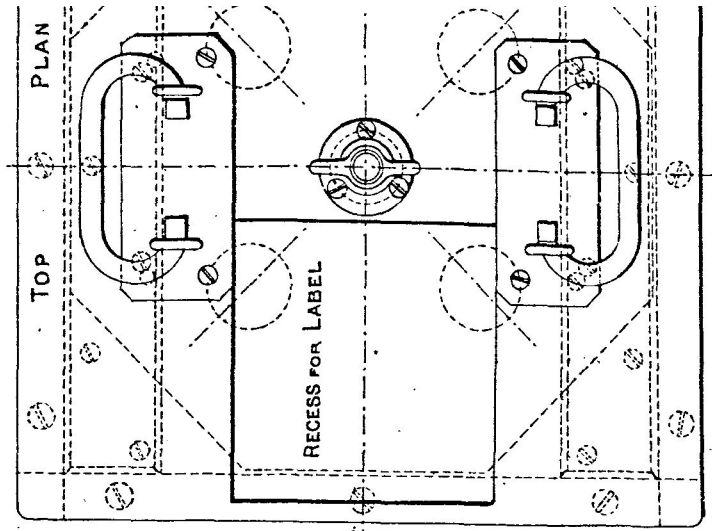
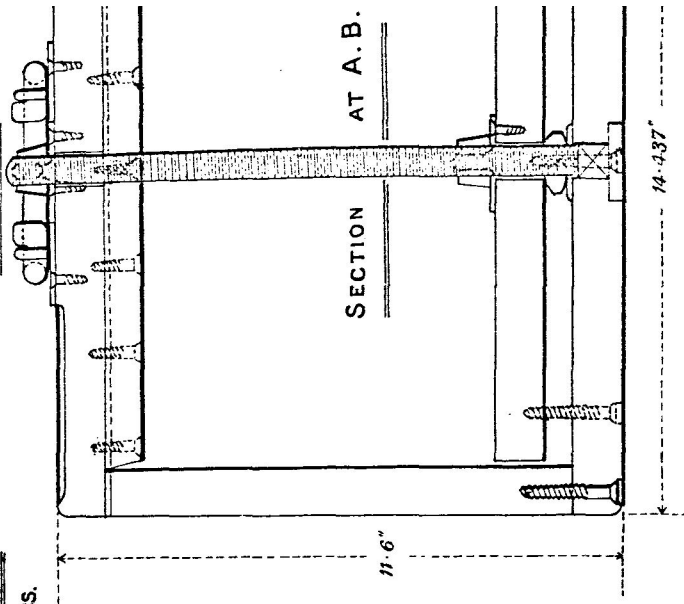
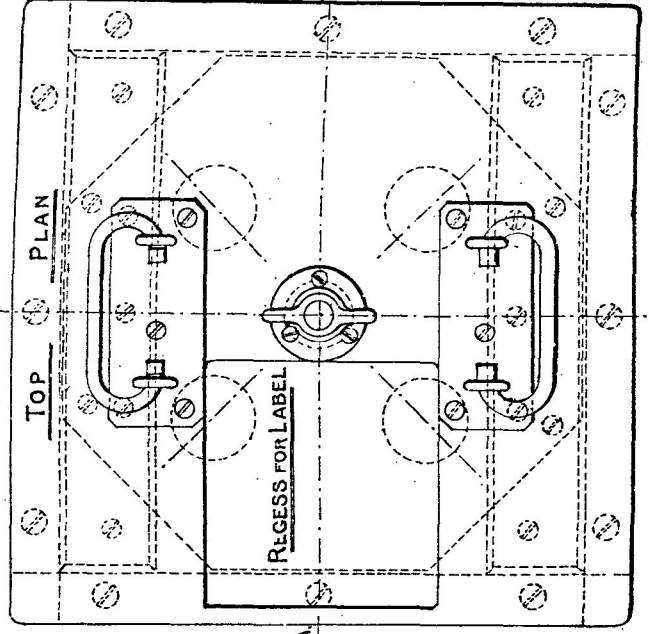
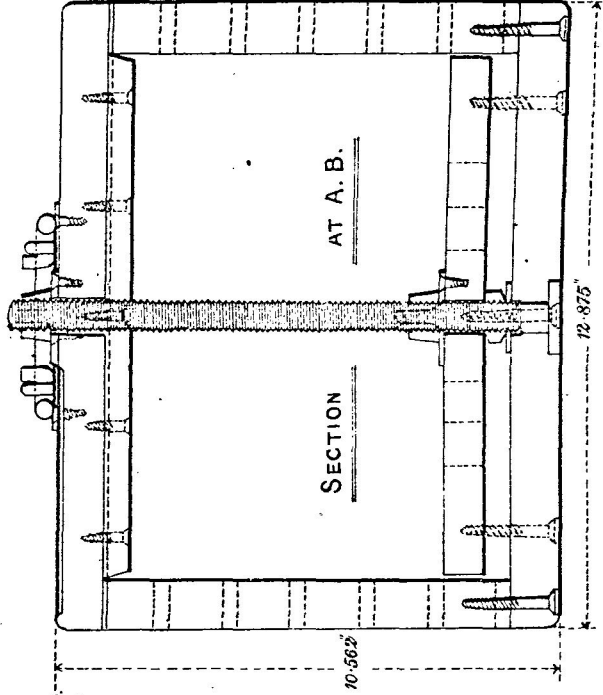
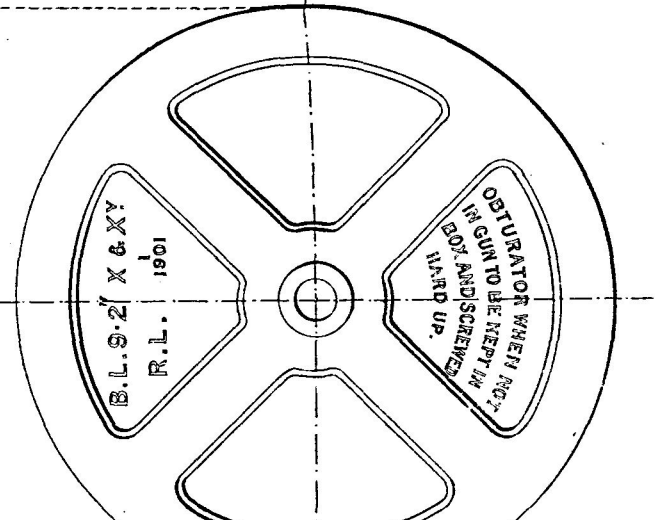
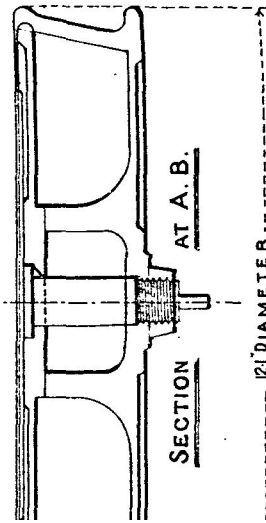
WOOD, WITH GUN METAL BOLT AND FLY NUTS TO HOLD 3 PADS & 3 SETS OF DISCS.

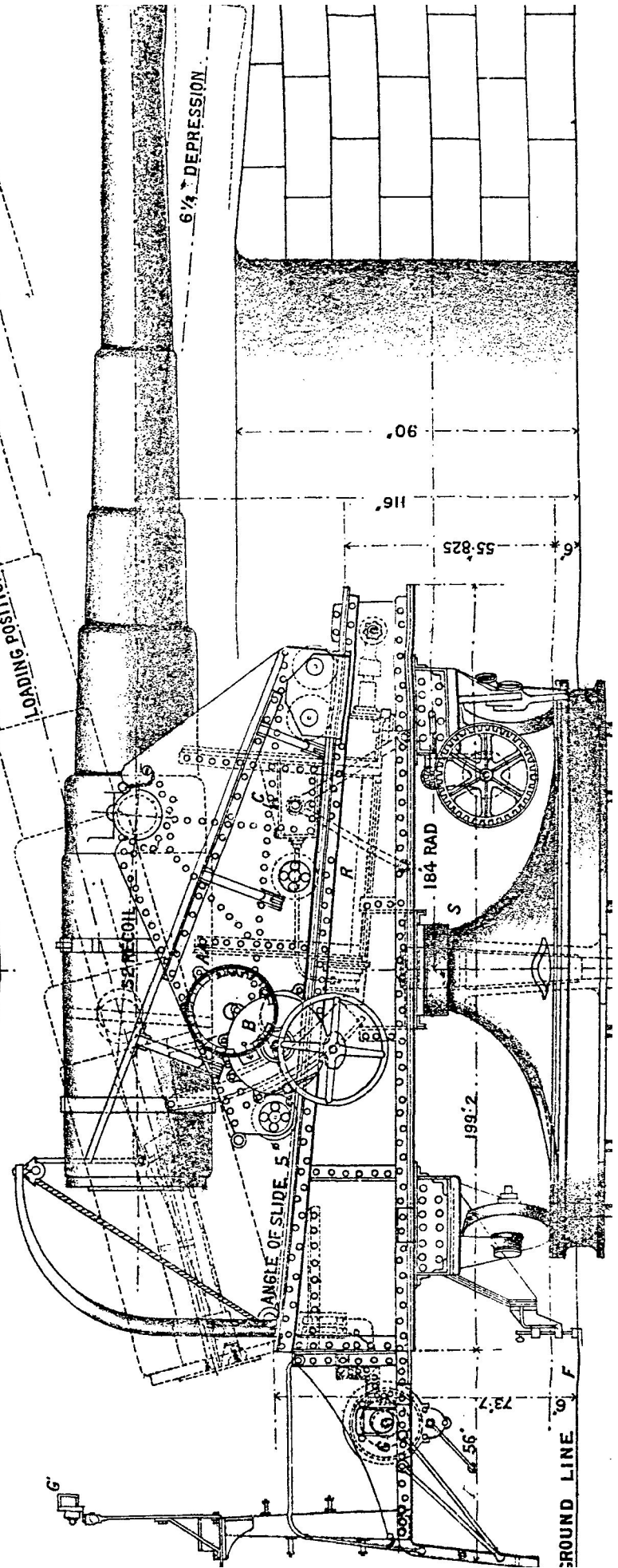
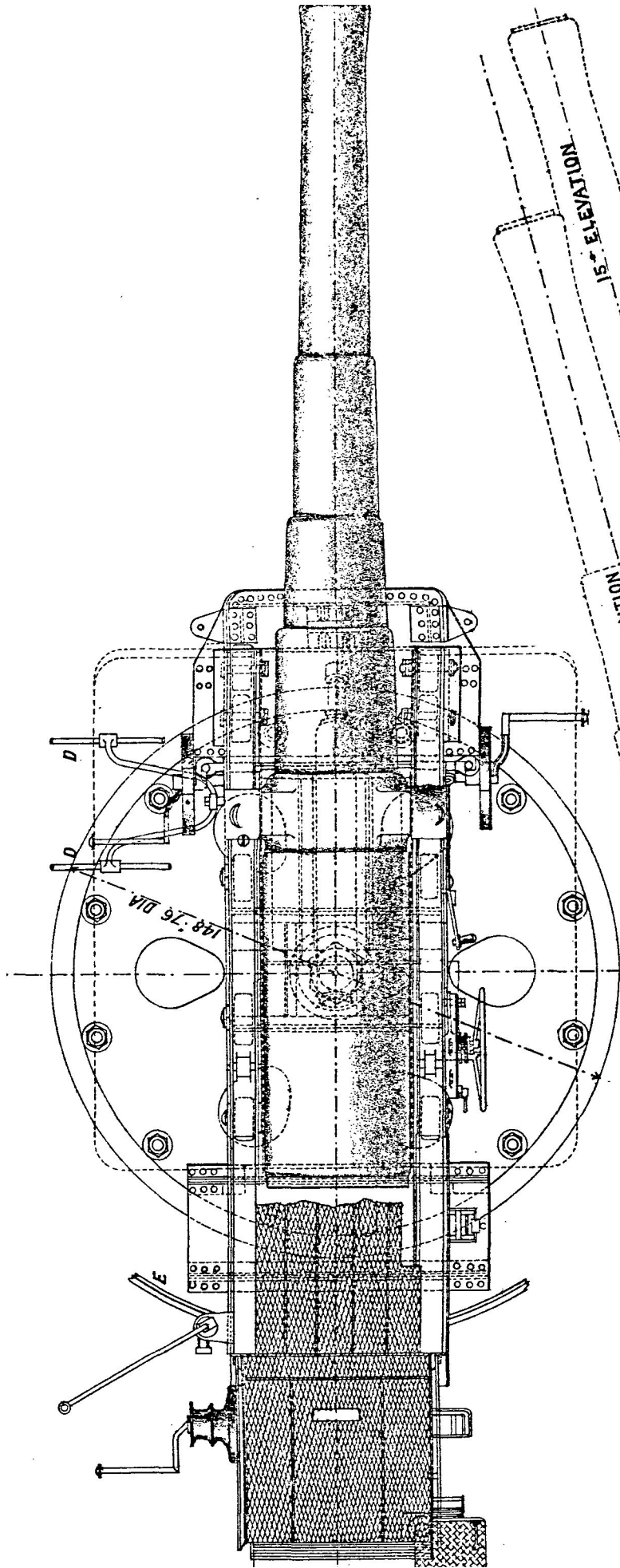
SCALE $\frac{1}{4}$.

FOR STEEP CONED, B.L. 9.2 INCH (MARK I)

OBTURATOR & ONE ADJUSTING DISC. MKS. X & XY GUNS.

SCALE $\frac{1}{4}$.

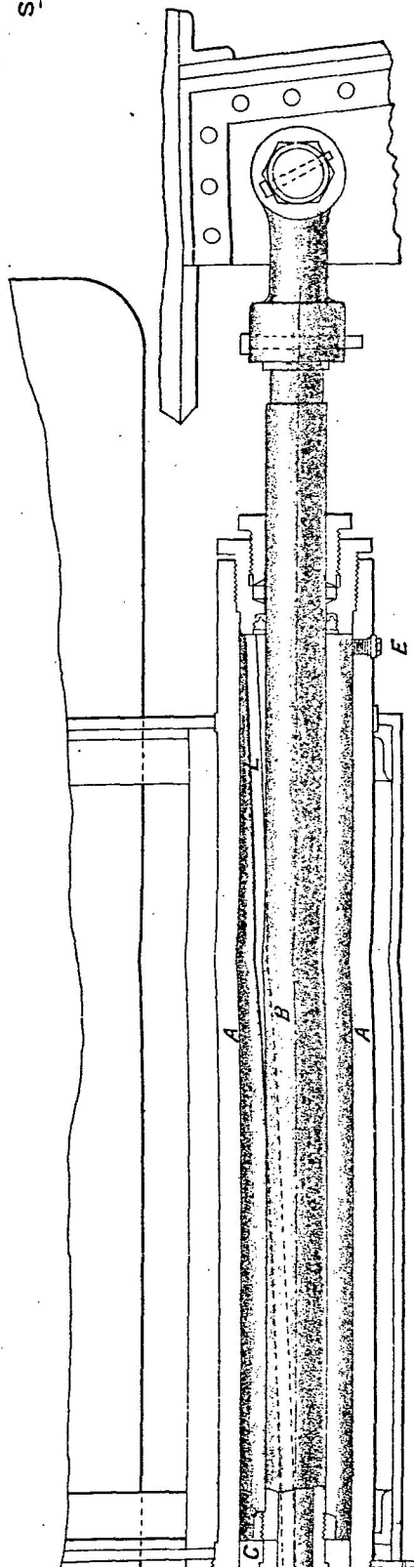




CARRIAGE, WITH SLIDE B. L., 9.2 INCH, BARBETTE, MARK I.

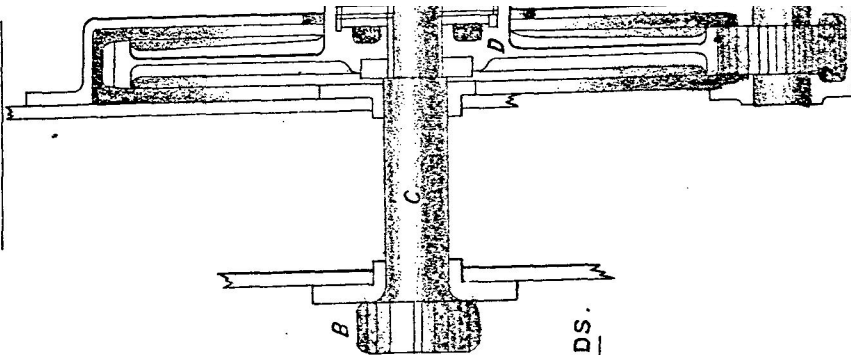
SECTION OF HYDRAULIC BUFFER.

SCALE 1/12.



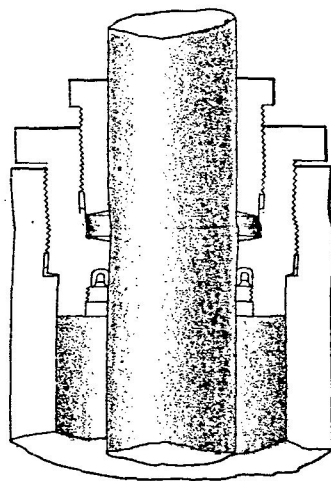
SECTION OF ELEVATION

SCALE 1/8.



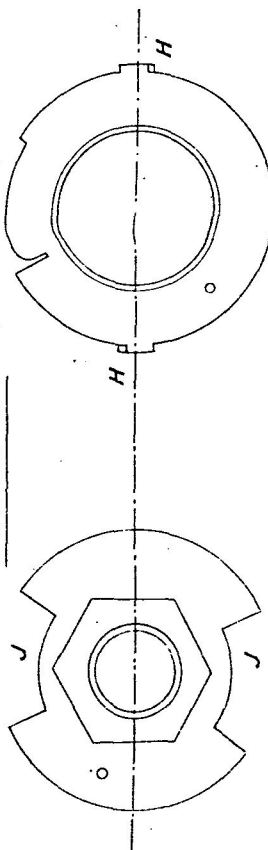
ENLARGED SECTION OF PACKING GLANDS.

SCALE 1/6.



END VIEW OF VALVE.

SCALE 1/5.



D VIEW OF PISTON.

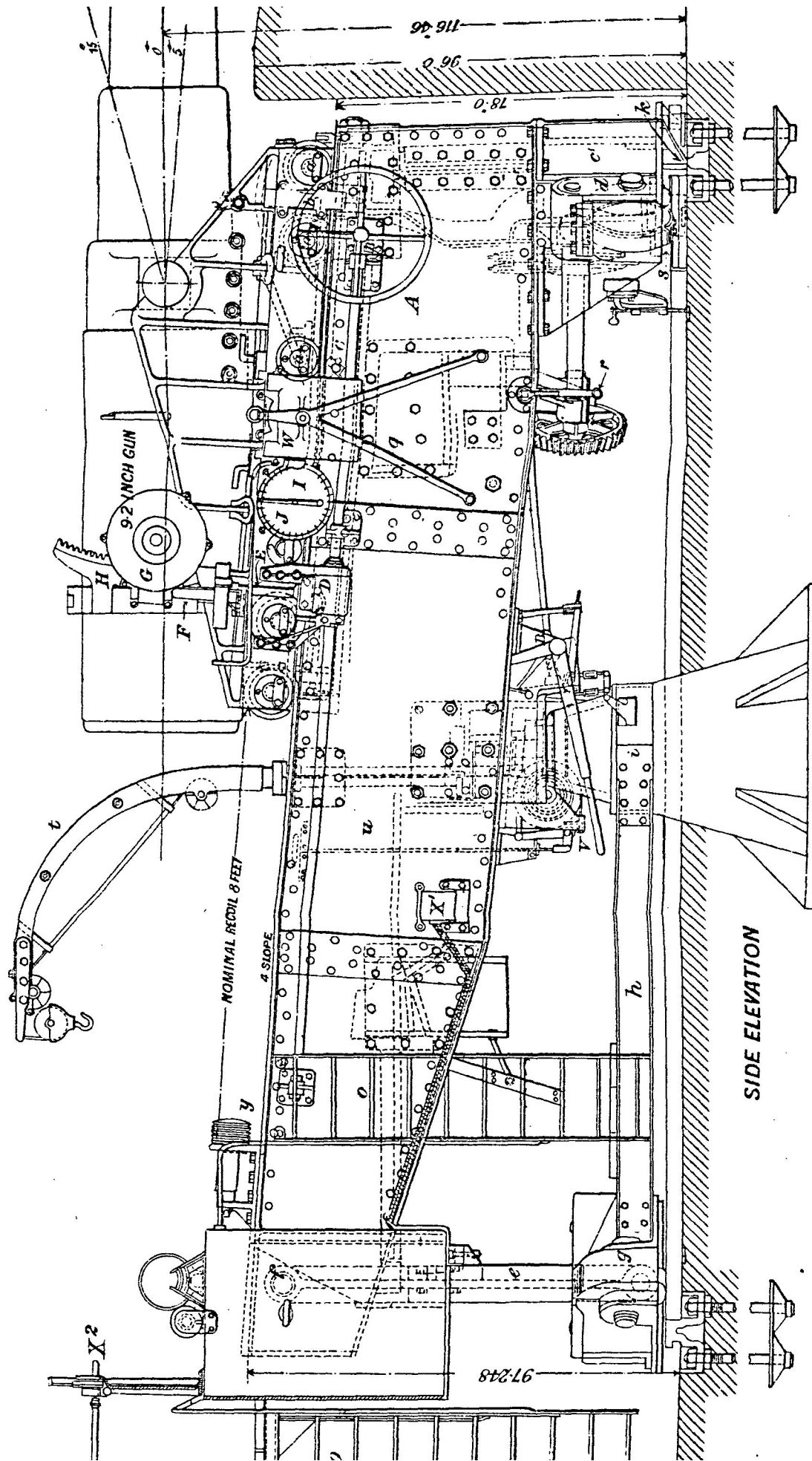
CARRIAGE, GARRISON, BARBETTE, B. L., 9.2 INCH, MARK II.

Plate

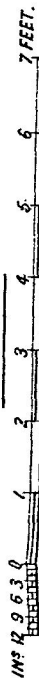
STEEL ALSO 10 INCH.

SLIDE L, BARBETTE, B. L., 9.2. MARK II.

STEEL ALSO 10 INCH.



SCALE.



17.5.1901.

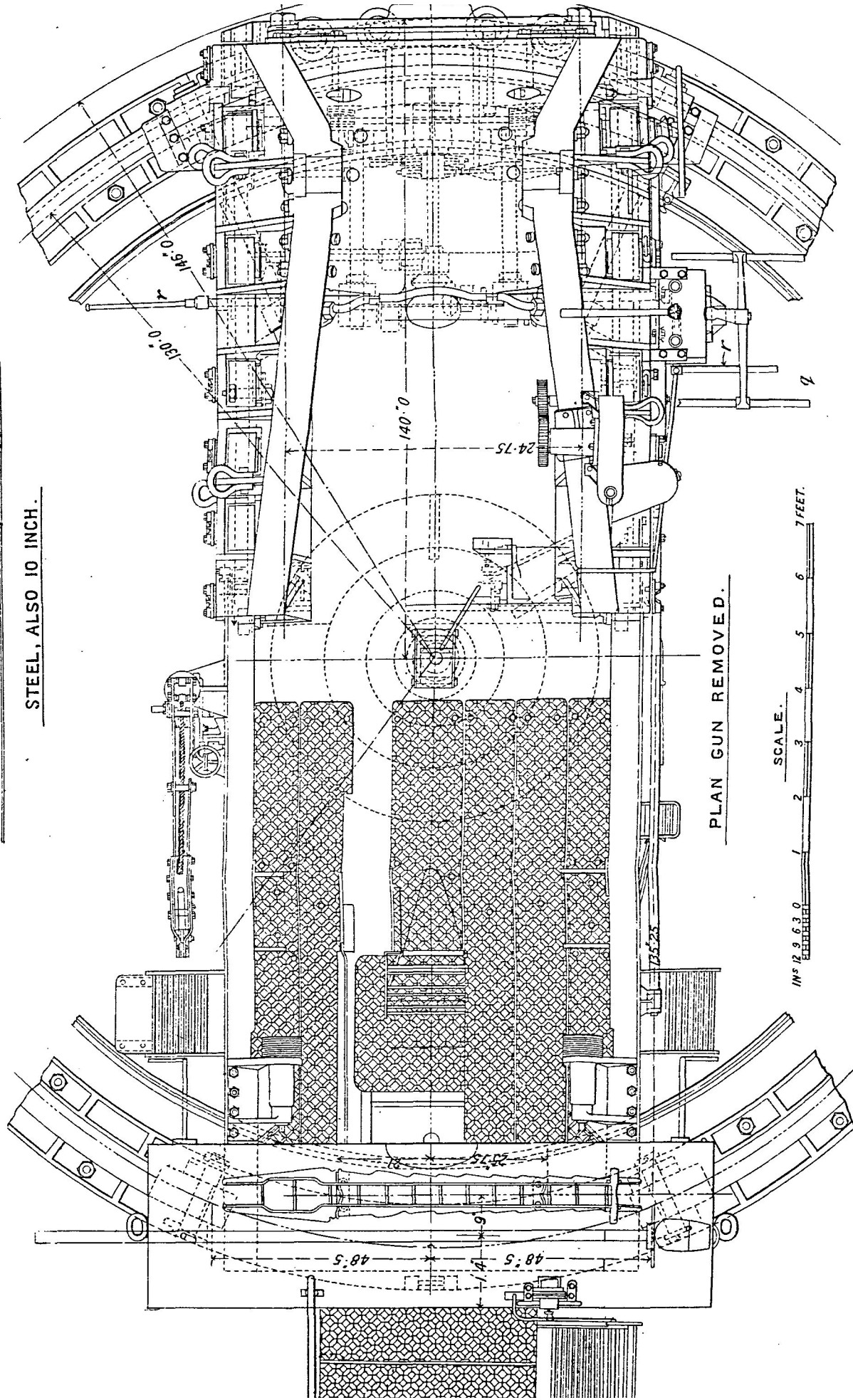
E. Weller & Grahams, Ltd.

CARRIAGE, GARRISON, BARBETTE, B. L., 9.2 INCH, MARK II.

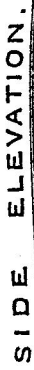
STEEL, ALSO 10 INCH

SLIDE, L., B. L., BARBETTE, 10-INCH, MARK II.

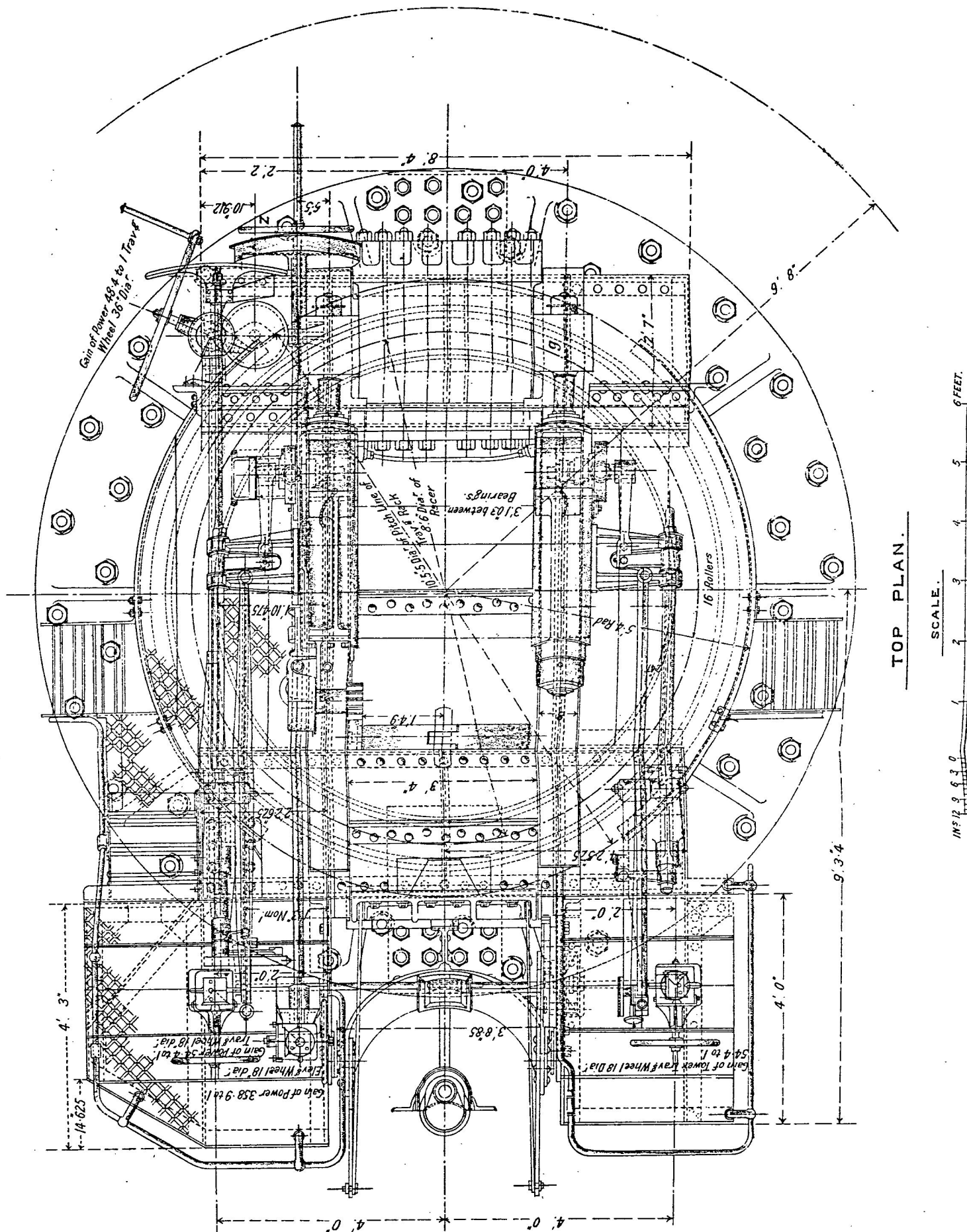
STEEL, ALSO 10 INCH.



SLIDE, L, BARBETTE, B. L., 9.2 INCH, MARK III.

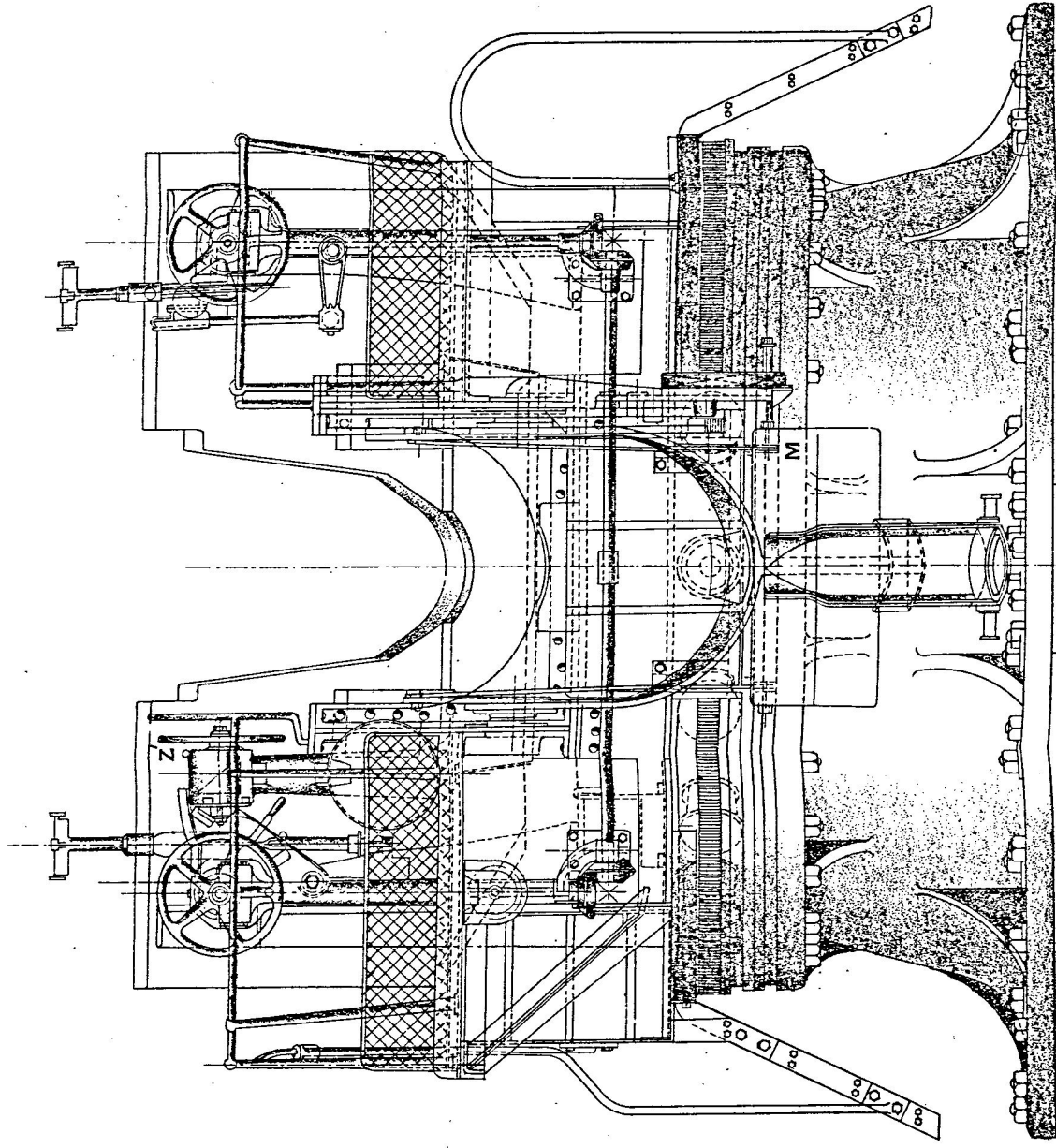


SLIDE, L, BARBETTE, B. L., 9.2 INCH, MARK III.



CARRIAGE, GARRISON, BARBETTE, B. L., 9.2 INCH, MARK III.

SLIDE, L, BARBETTE, B. L. 9.2 INCH, MARK III.



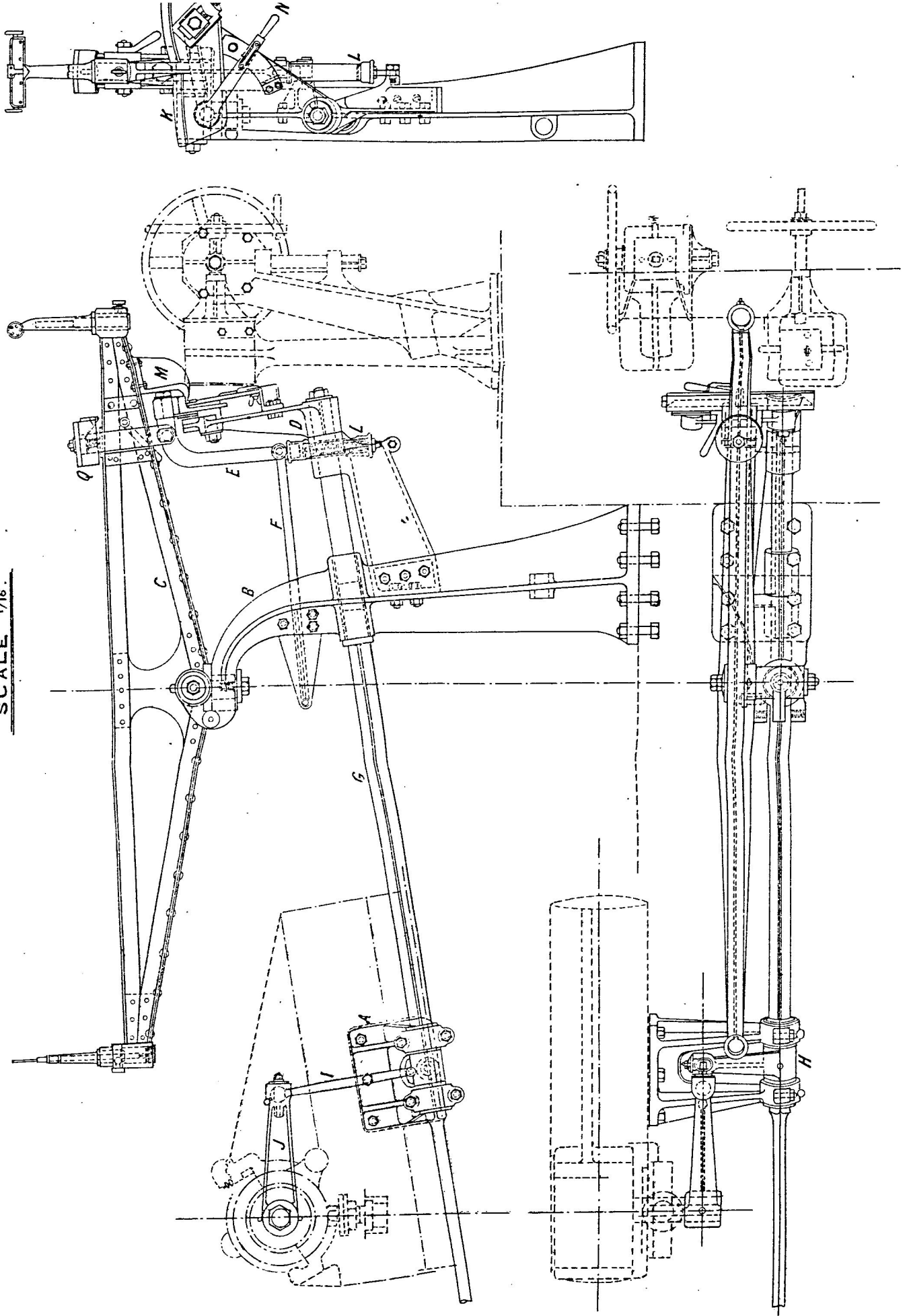
REAR END VIEW.



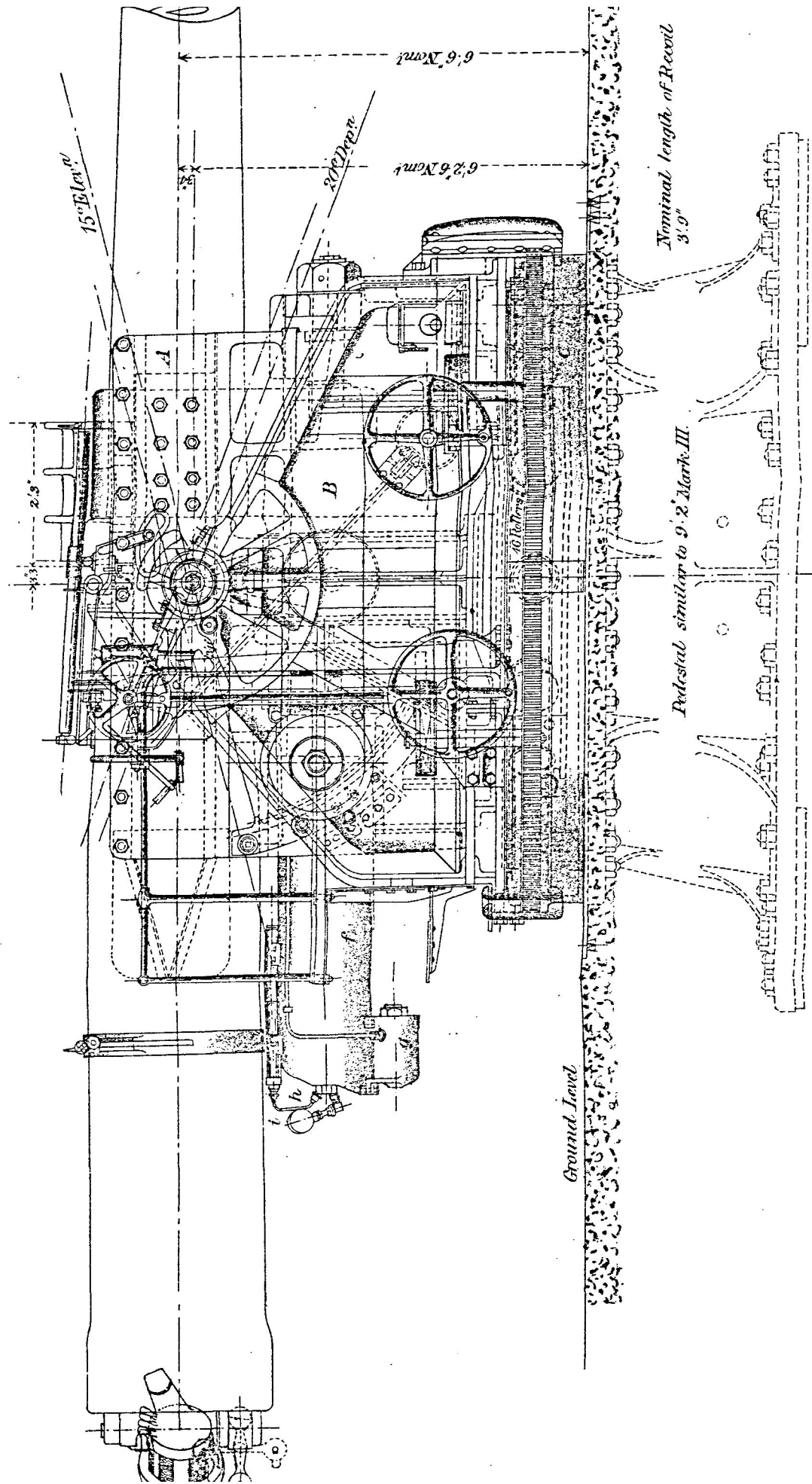
SLIDE, L, BARBETTE. B. L., 9.2 INCH, MARK III.

GENERAL ARRANGEMENT OF AUTOMATIC SIGHTS LEFT HAND SIDE.

SCALE 1/16.



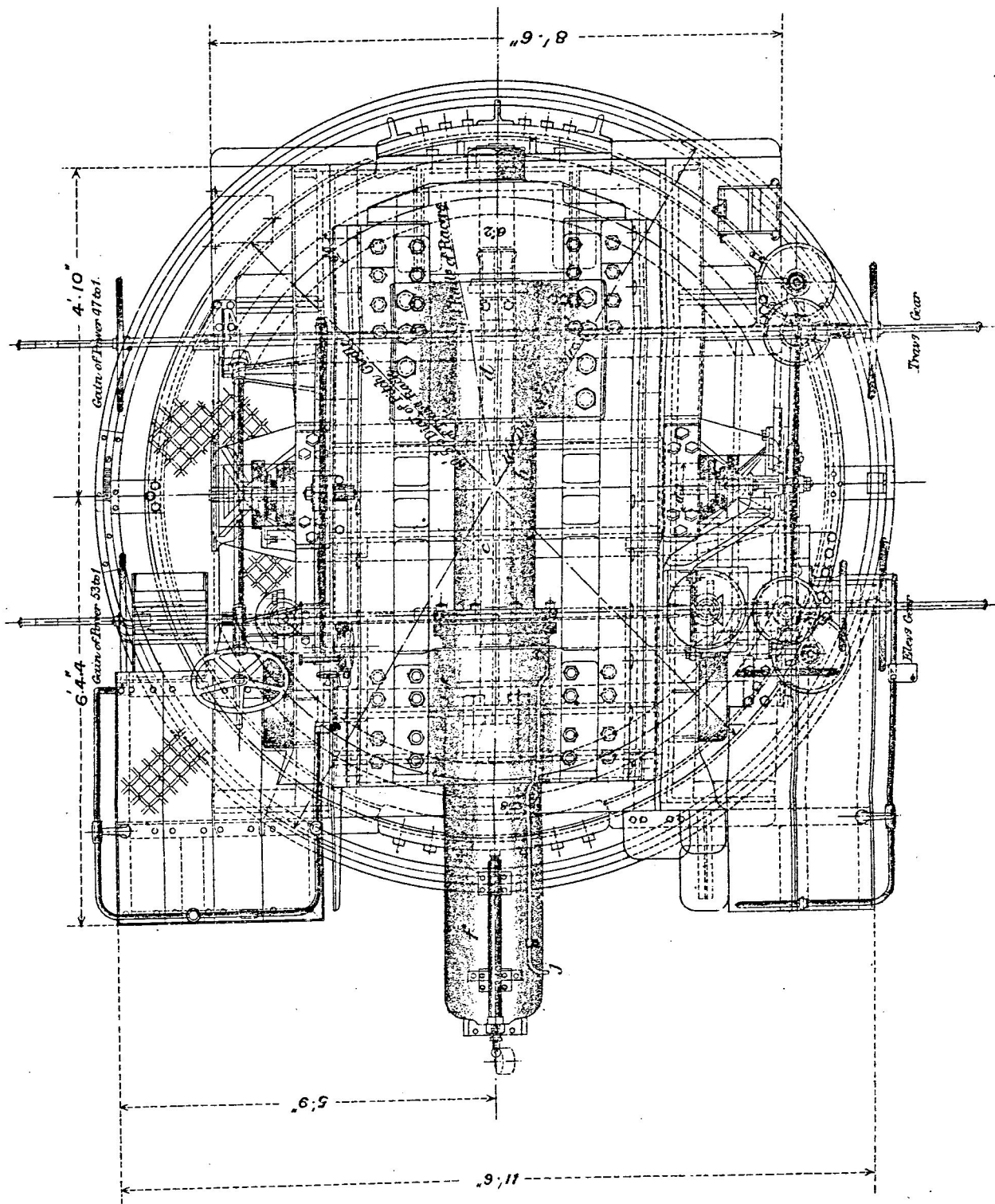
CARRIAGE GARRISON, BARBETTE, B.L., 9.2 INCH, MARK IV.



SIDE ELEVATION.

SCALE.

CARRIAGE. CARRISON, BARBETTE, B. L. 9.2 INCH. (MARK IV)

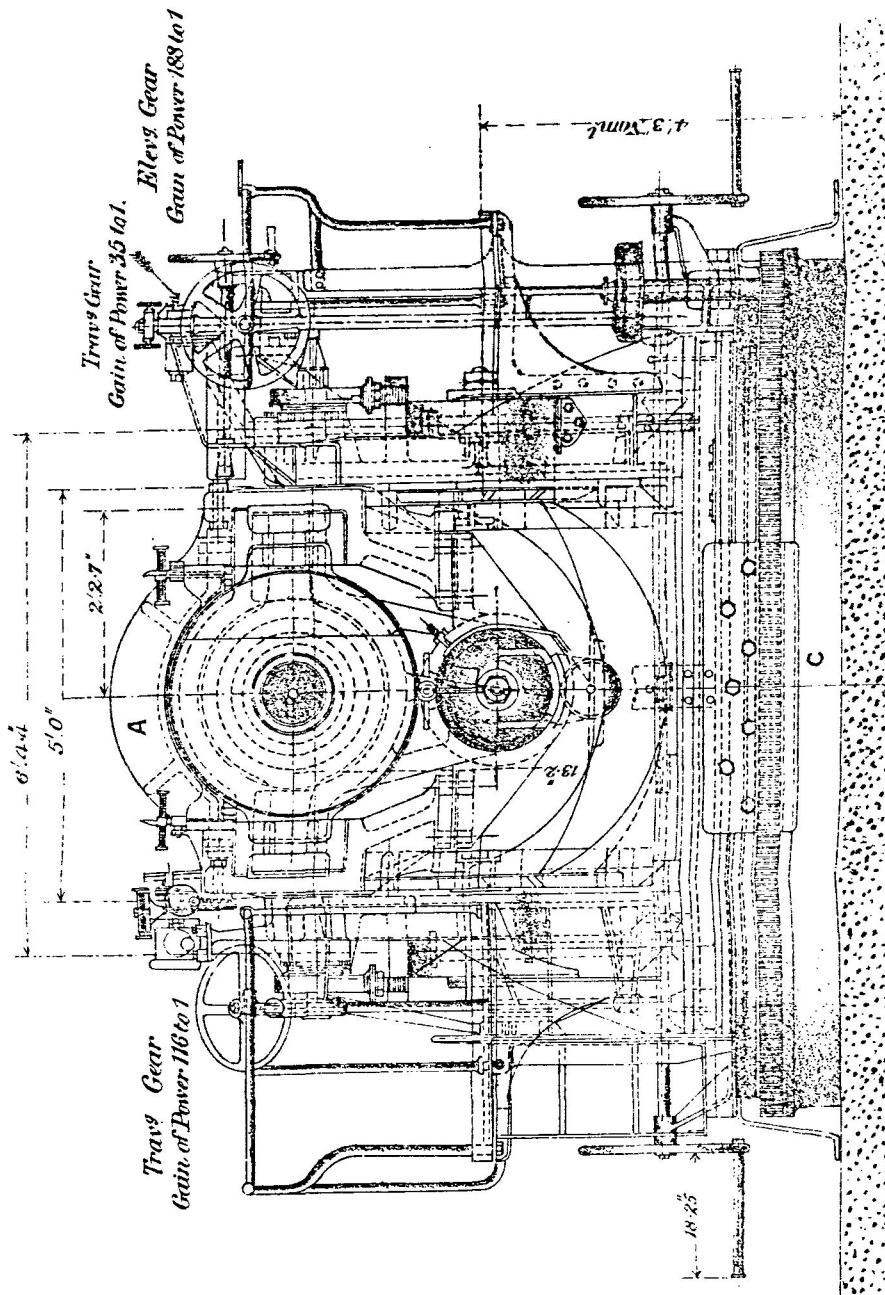


TOP PLAN.

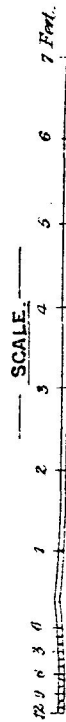
SCALE.



CARRIAGE. CARRISON. BARBETTE, B.L., 9.2 INCH, MARK IV.



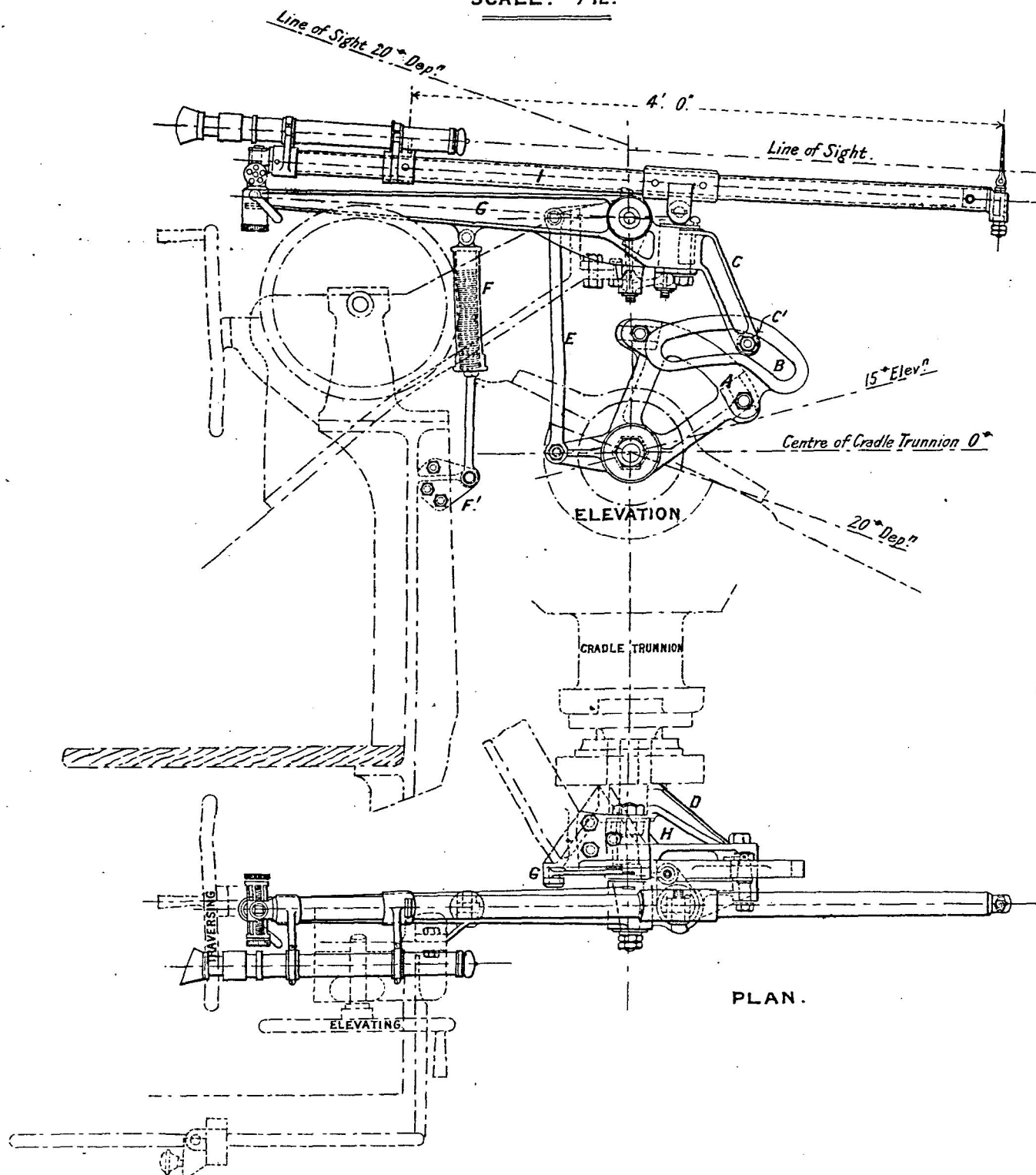
REAR END VIEW.



CARRIAGE, GARRISON, BARBETTE, B. L. 9.2 INCH, MARK IV.

GENERAL ARRANGEMENT OF AUTOMATIC SIGHTS, RIGHT SIDE.

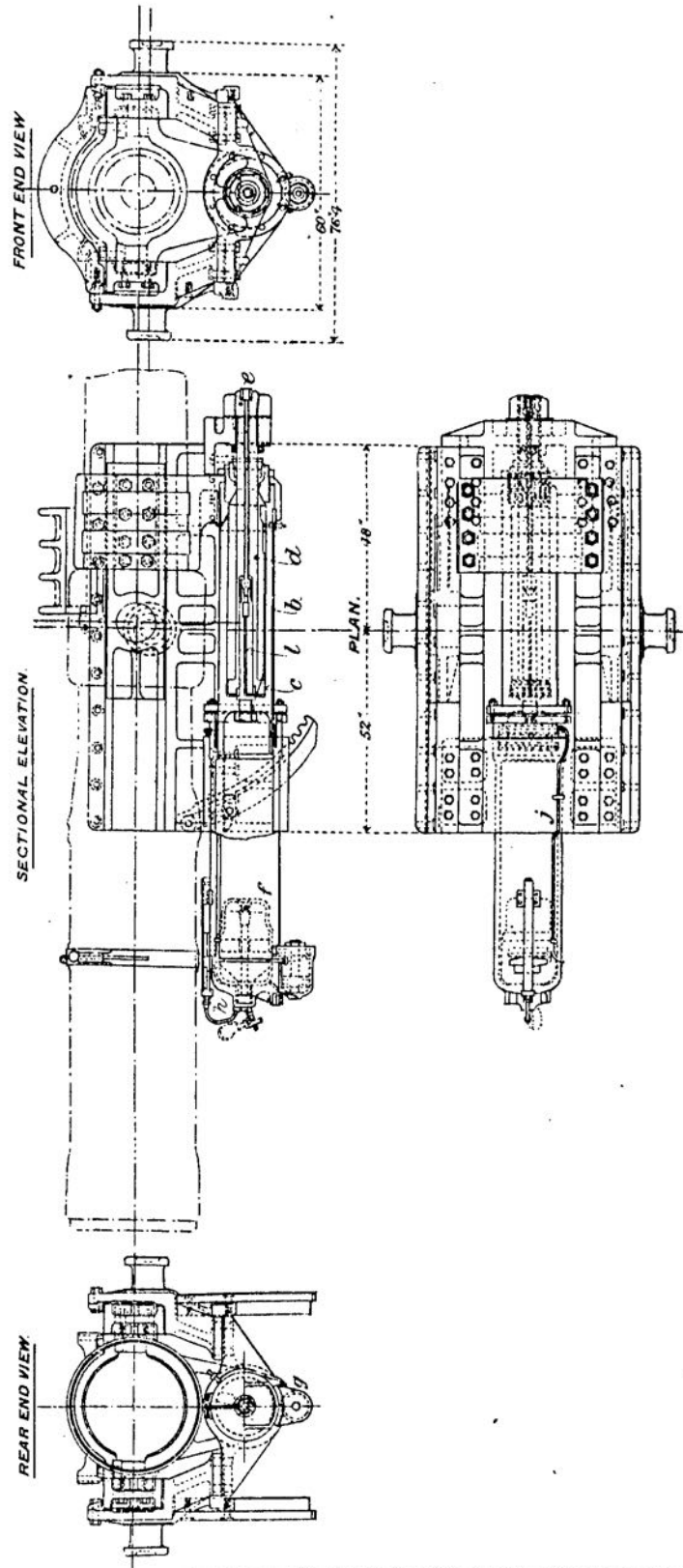
SCALE. $\frac{1}{12}$.

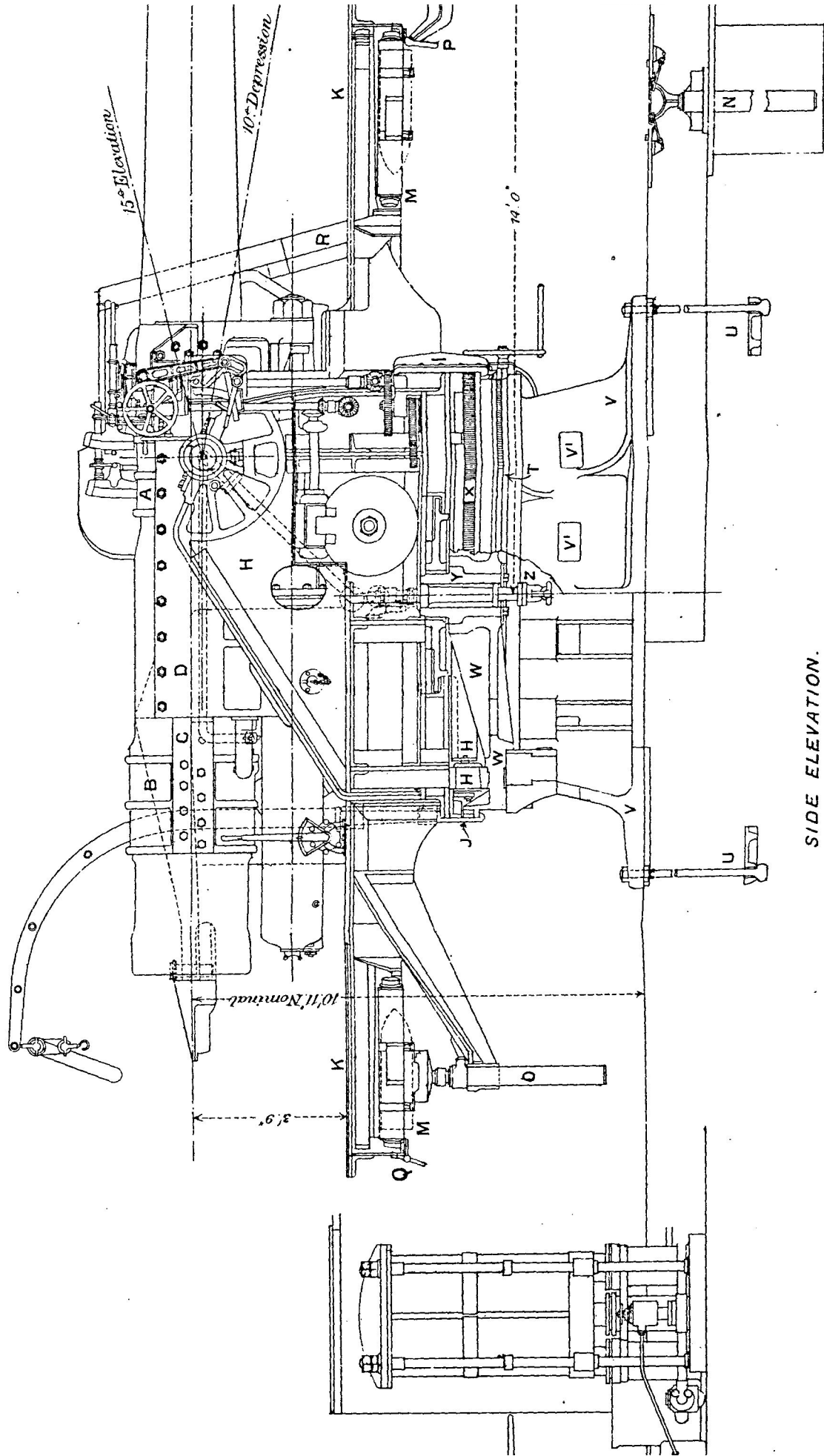


ARMSTRONG, GARRISON, DARBEISE D.L. 3-1/2 INCH (MARK IV)

General arrangement of Cradle with Air Cylinder and Hydraulic Buffer.

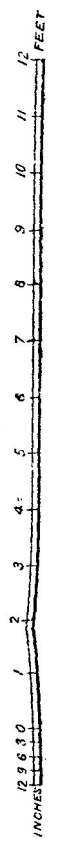
SCALE 1/48.

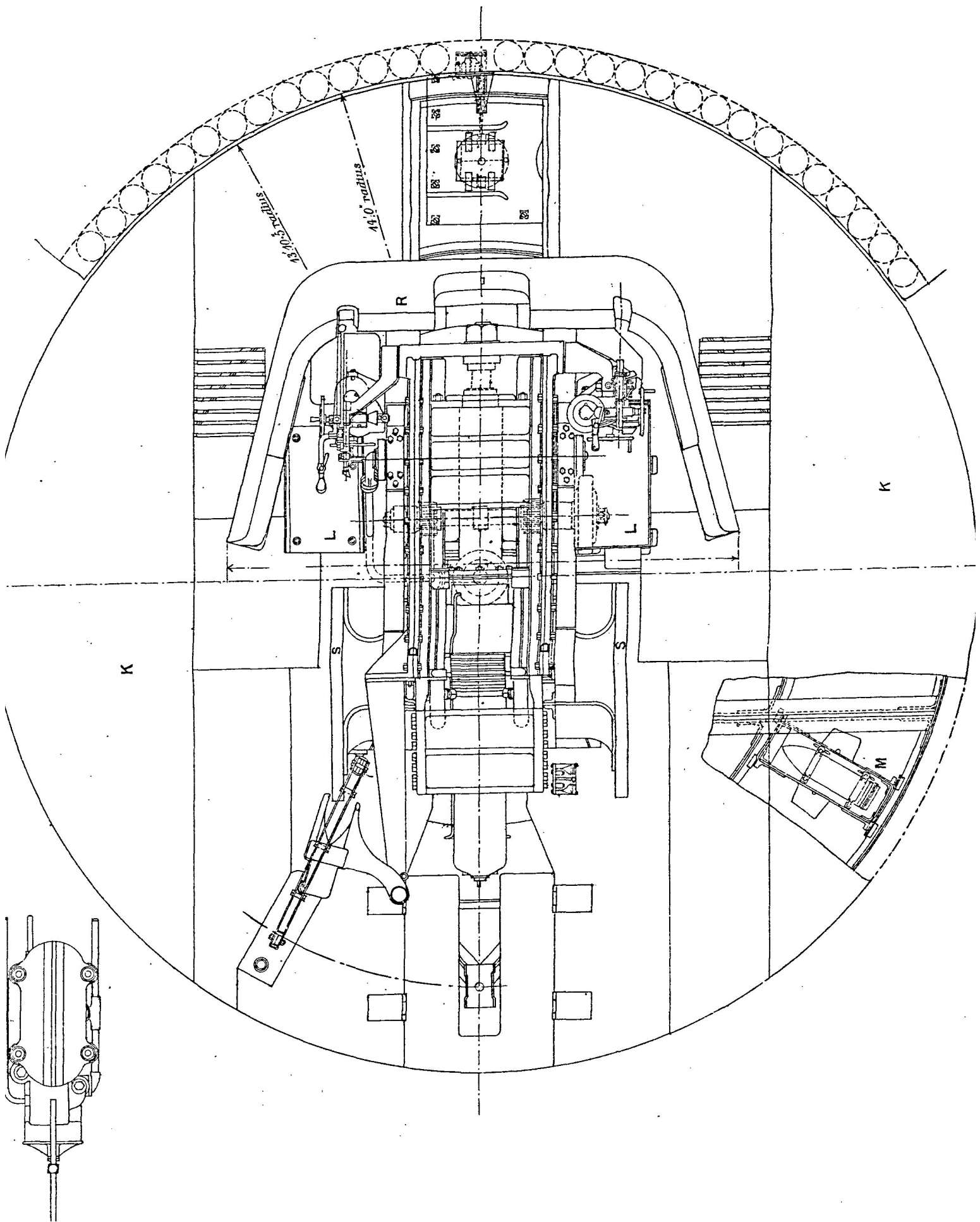




SIDE ELEVATION.

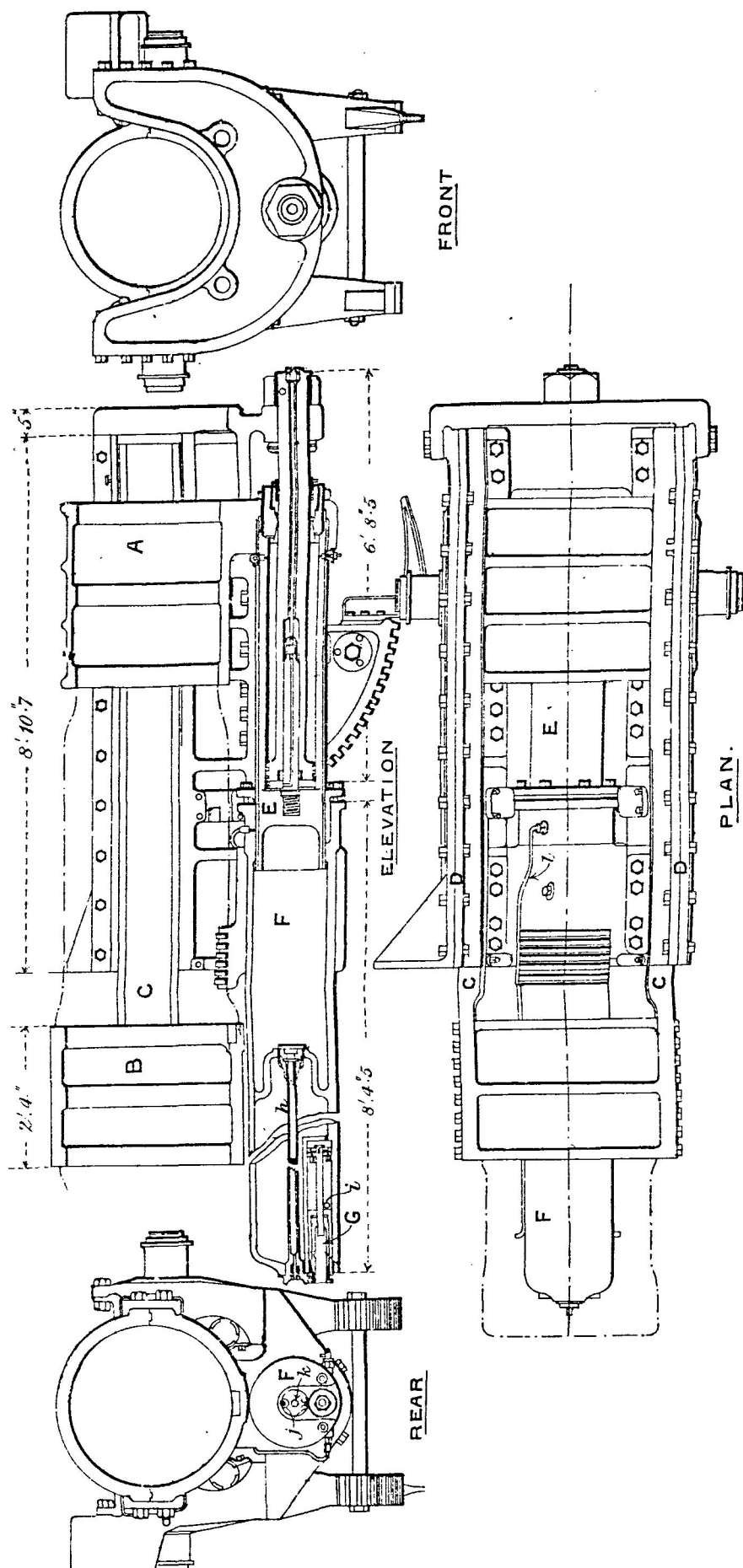
SCALE.



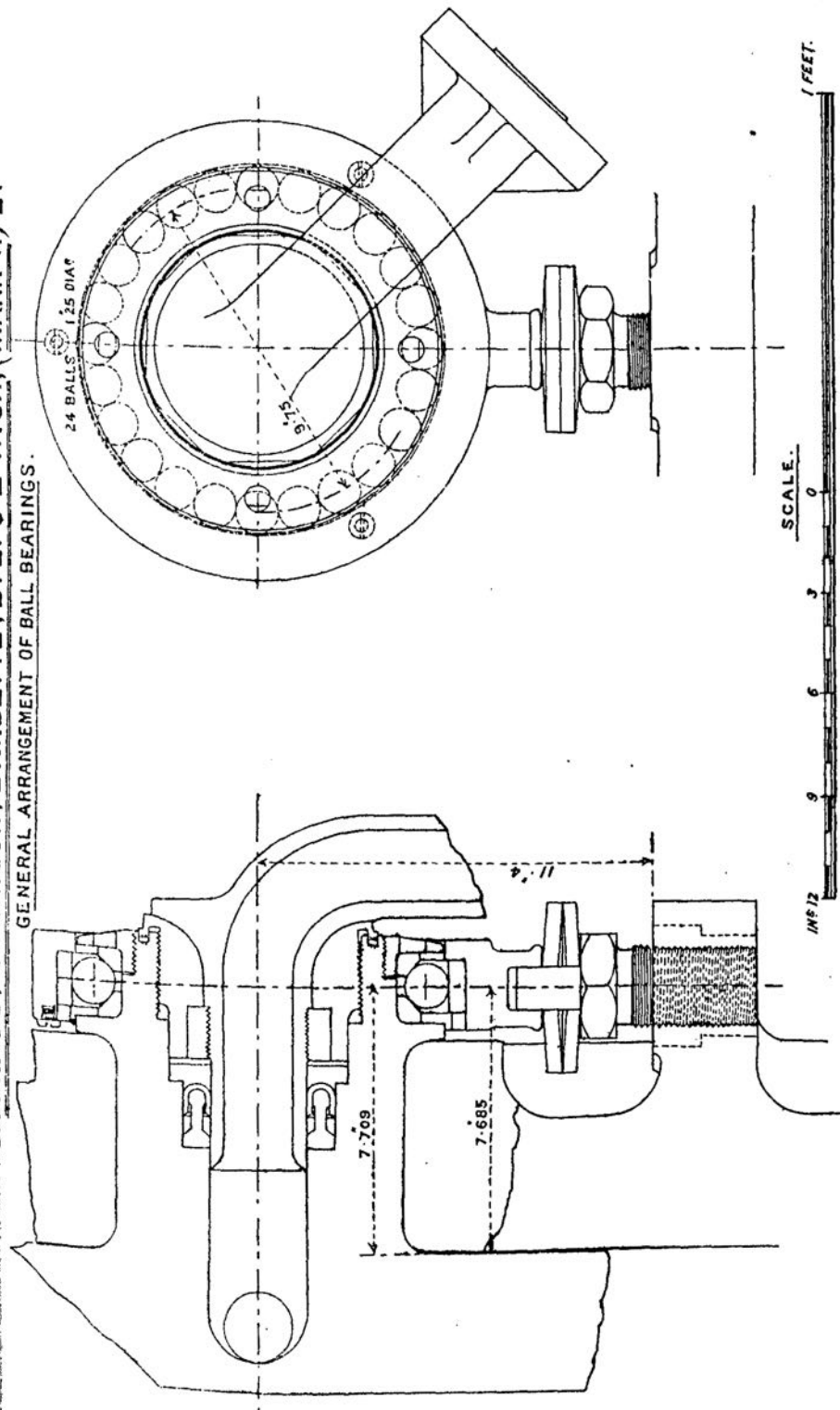


CARRIAGE, CARRISON, BARBETTE, B.L. 9.2 INCH (MARK V) L.

— *Ordnance* —
GENERAL ARRANGEMENT.
Scale 1/32

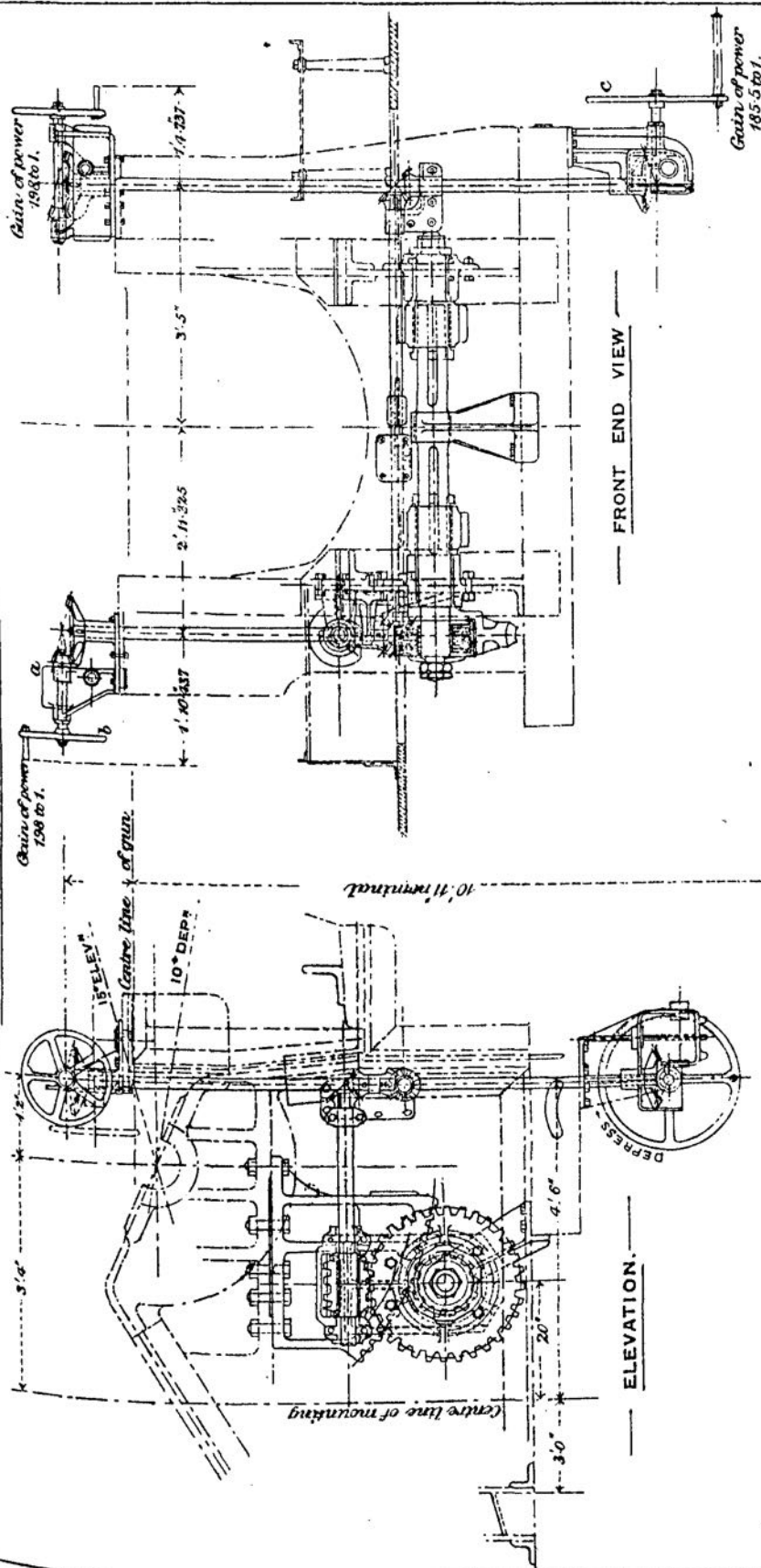


1237 S. 1901.
 GENERAL ARRANGEMENT OF BALL BEARINGS.

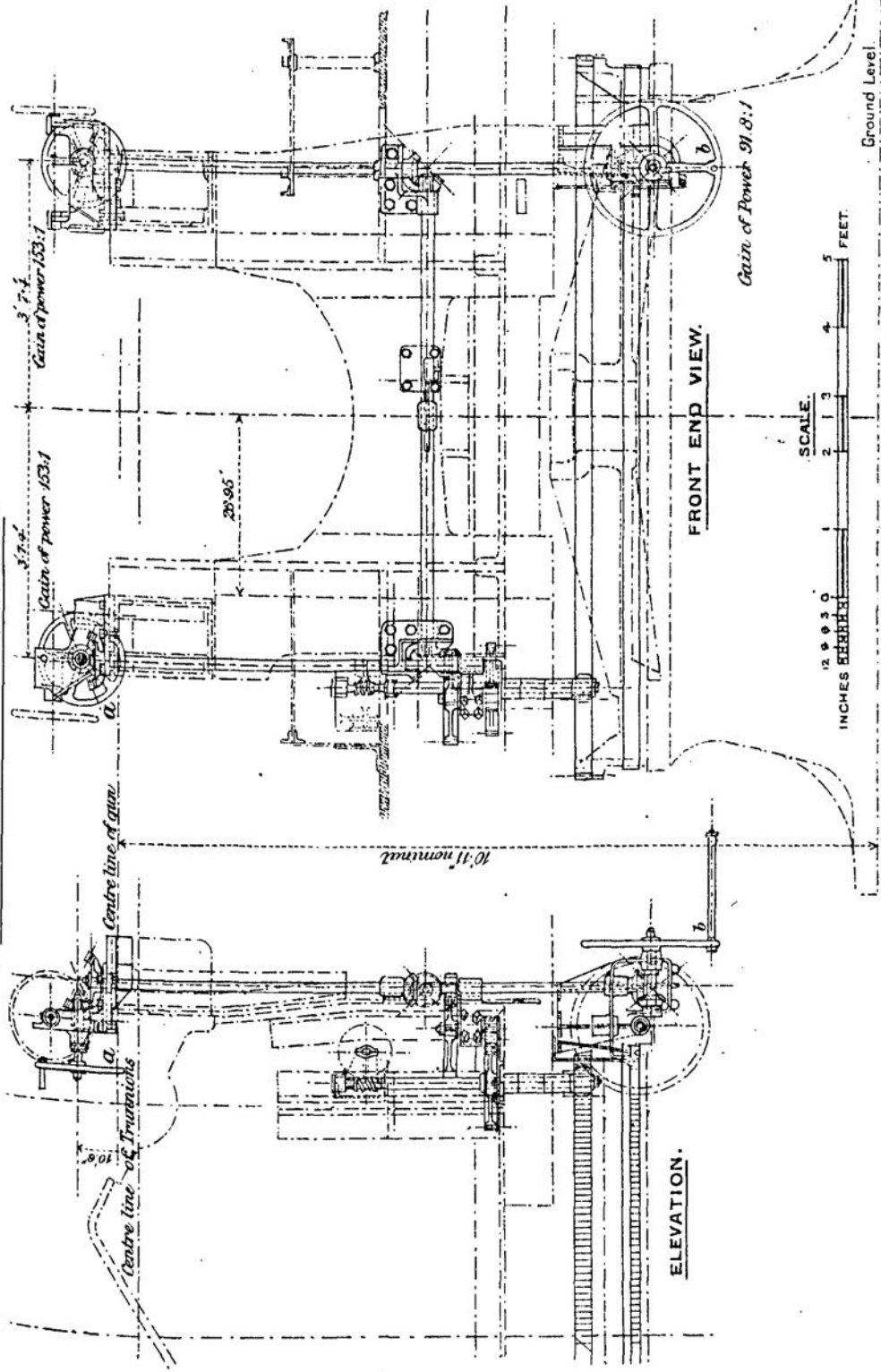


E. Weller & Grahams, Ltd. Litho. London.

GENERAL ARRANGEMENT OF GEAR ELEVATING.



CARRIAGE, GARRISON, BARBELLE, B.L. 9.2 INCH. (MARK V.) L.
GENERAL ARRANGEMENT OF GEAR TRAVERSING.



Scale 1/8.

ELEVATION.

PLAN.

ELEVATING HAND WHEEL.

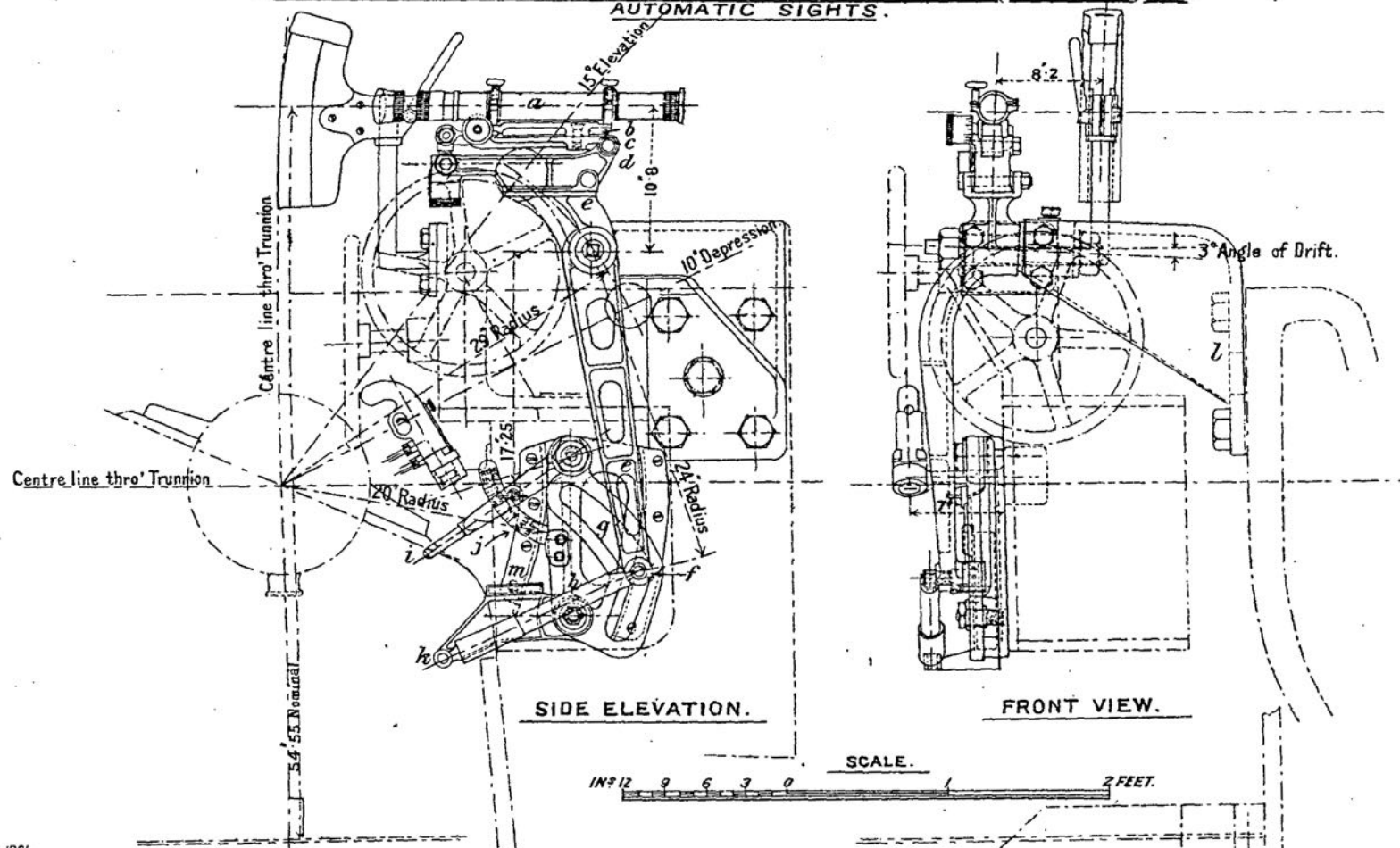
TRaversing HAND WHEEL.

REAR END VIEW

E. Weller & Grahams, Ltd. L.

E. Weller & Grahams, Ltd. L

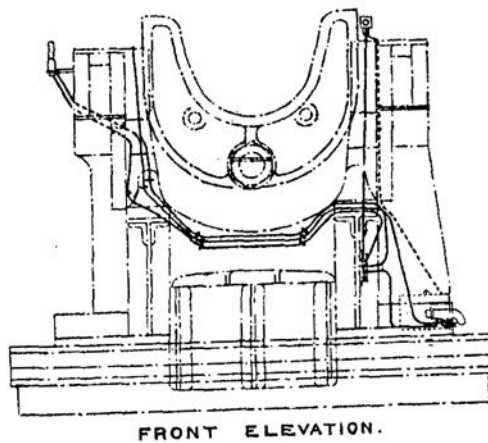
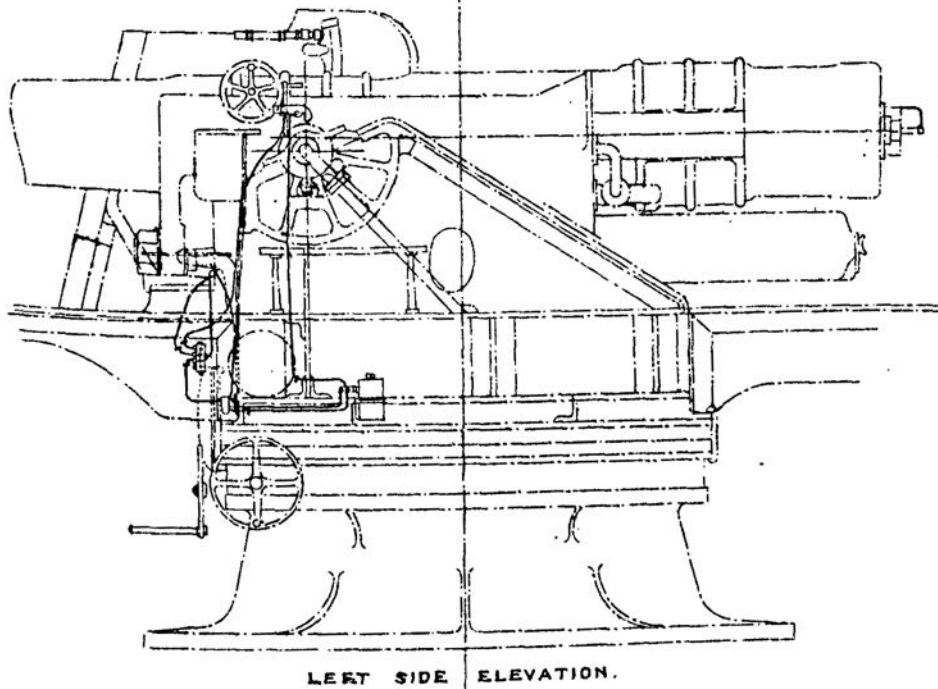
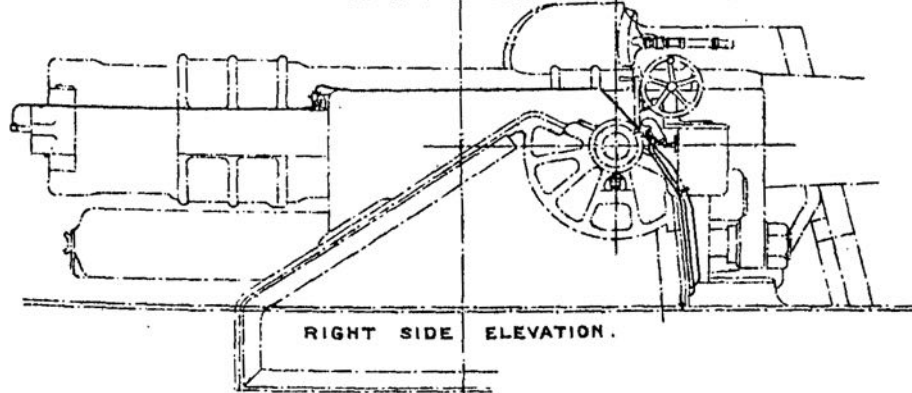
CARRIAGE, GARRISON, BARBETTE, B.L. 9.2 INCH, (MARK V.) L.
AUTOMATIC SIGHTS.



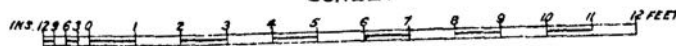
1237.5.1901.

E. Weller & Grahams, Ltd Litho. London.

CARRIAGE, GARRISON, BARBETTE, B.L. 9.2 INCH, (MARK V.) L.
GENERAL ARRANGEMENT OF GEAR FIRING ELECTRIC.



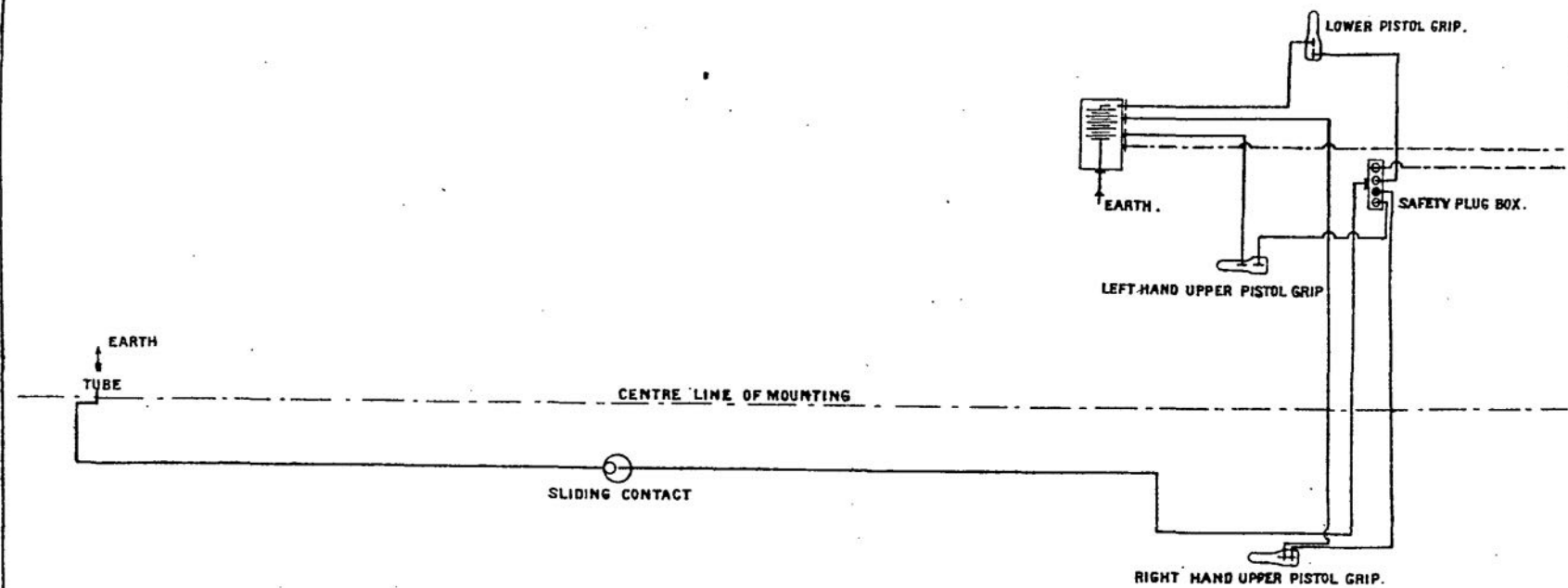
SCALE.



1237. S. 1901

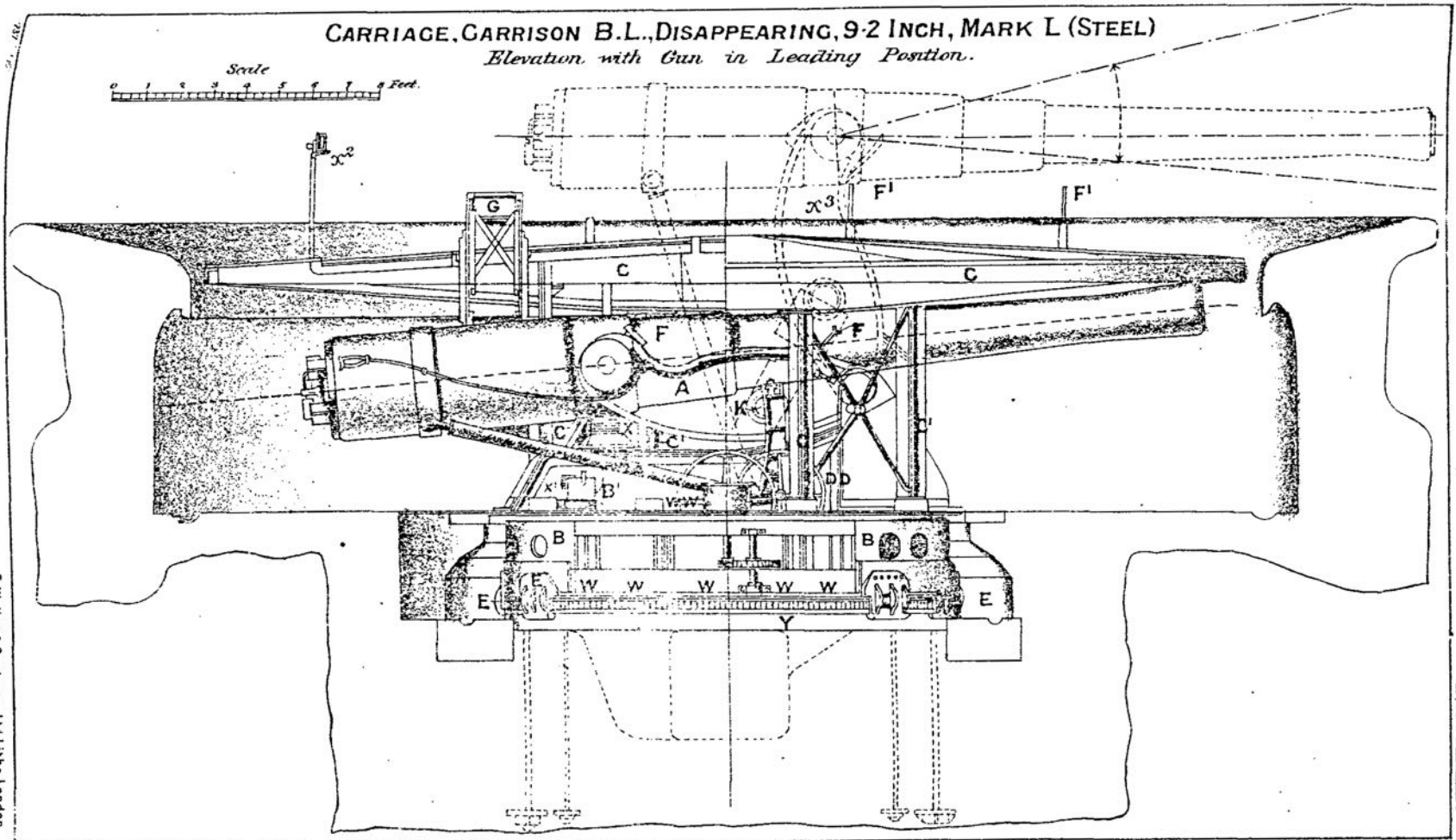
CARRIAGE, GARRISON, BARBETTE, B. L. 9.2 INCH, (MARK V.) L.

DIAGRAM OF GEAR FIRING ELECTRIC.

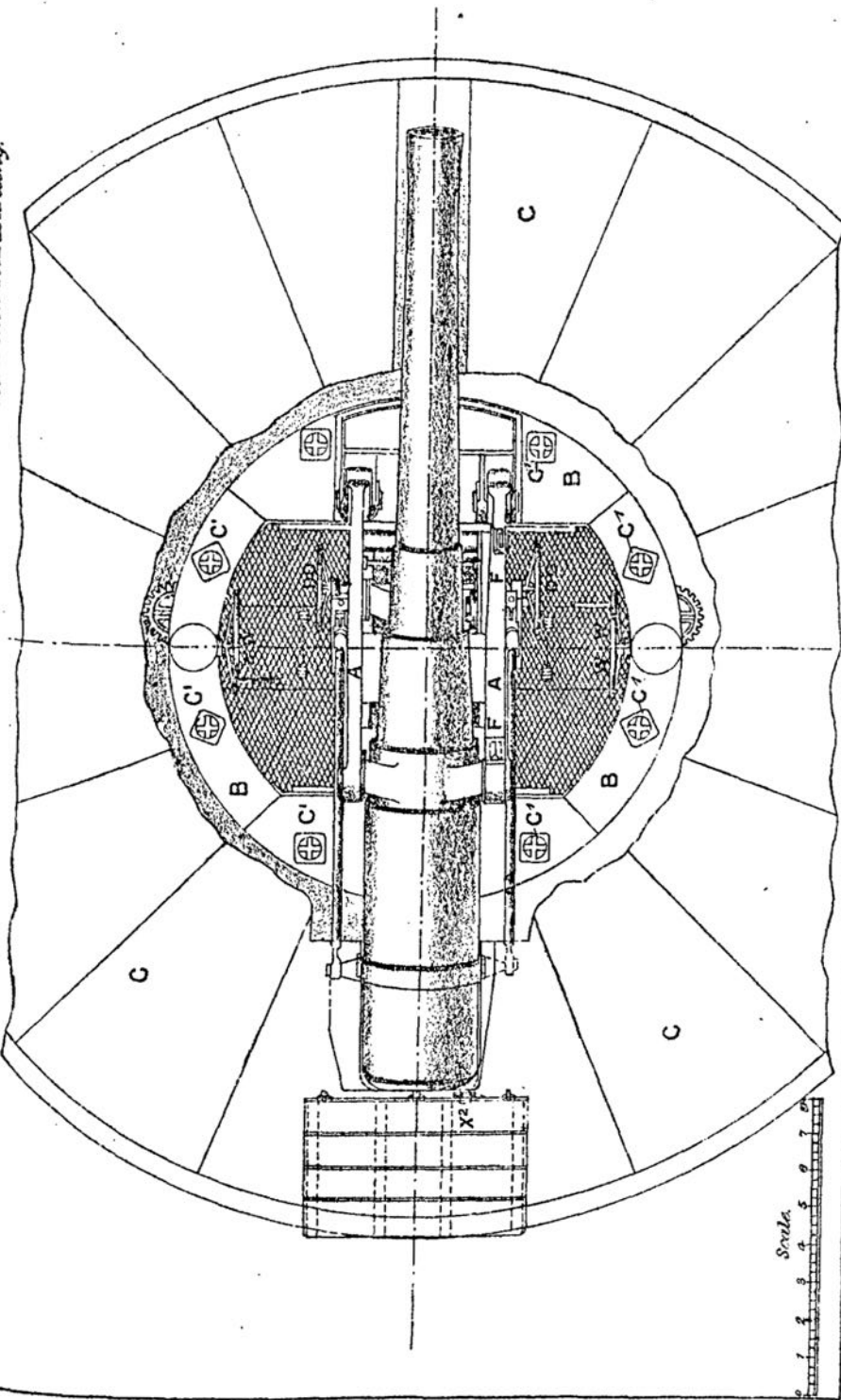


CARRIAGE, GARRISON B.L., DISAPPEARING, 9.2 INCH, MARK I (STEEL)
Elevation with Gun in Leading Position.

Scale
 0 1 2 3 4 5 6 Feet.

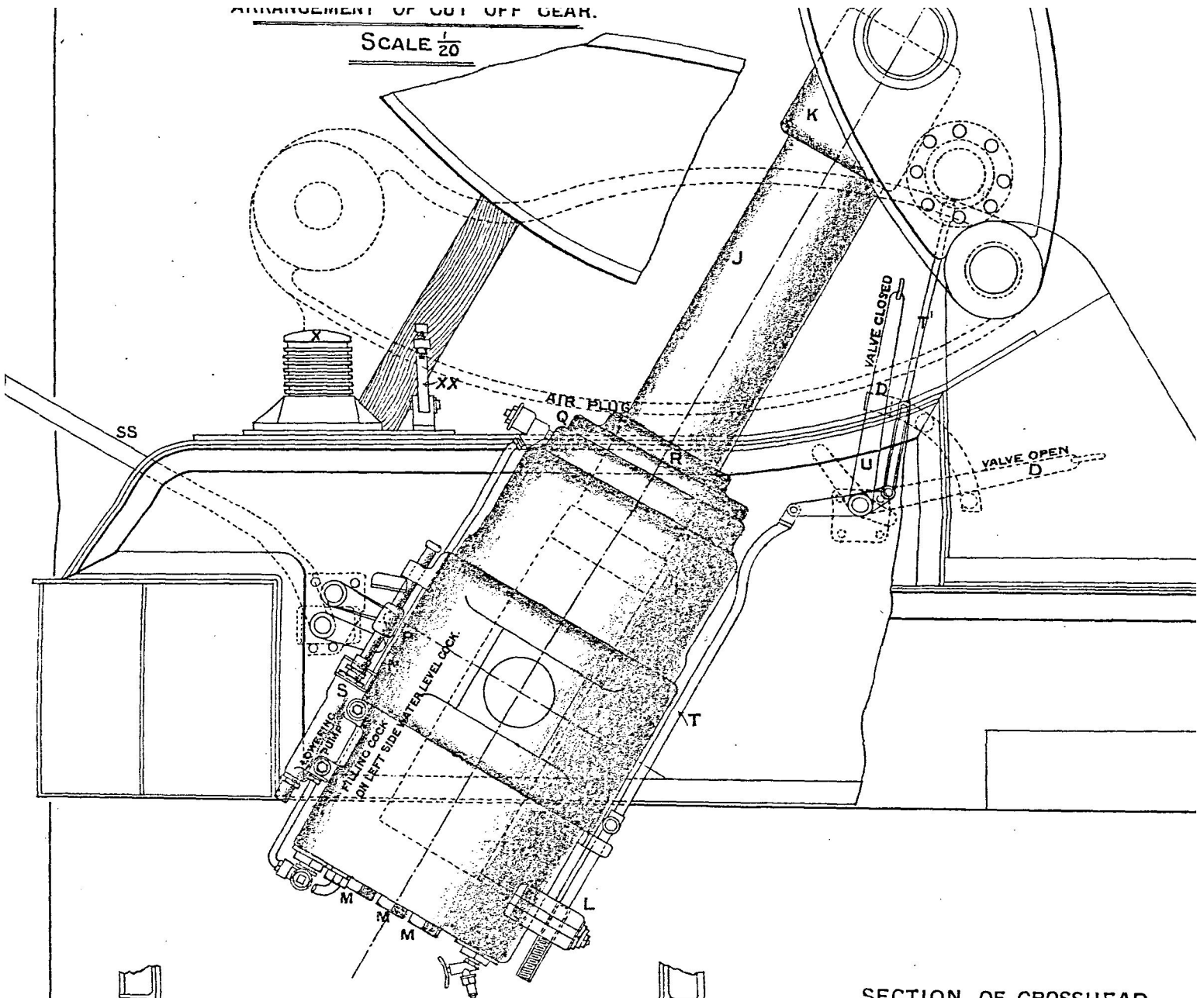


CARRIAGE, GARRISON, B. L., DISAPPEARING 9.2 INCH, MARK I.
 Plan with Gun in Loading Position and Part of Shield removed to show the Mounting.



ARRANGEMENT OF CUT OFF GEAR.

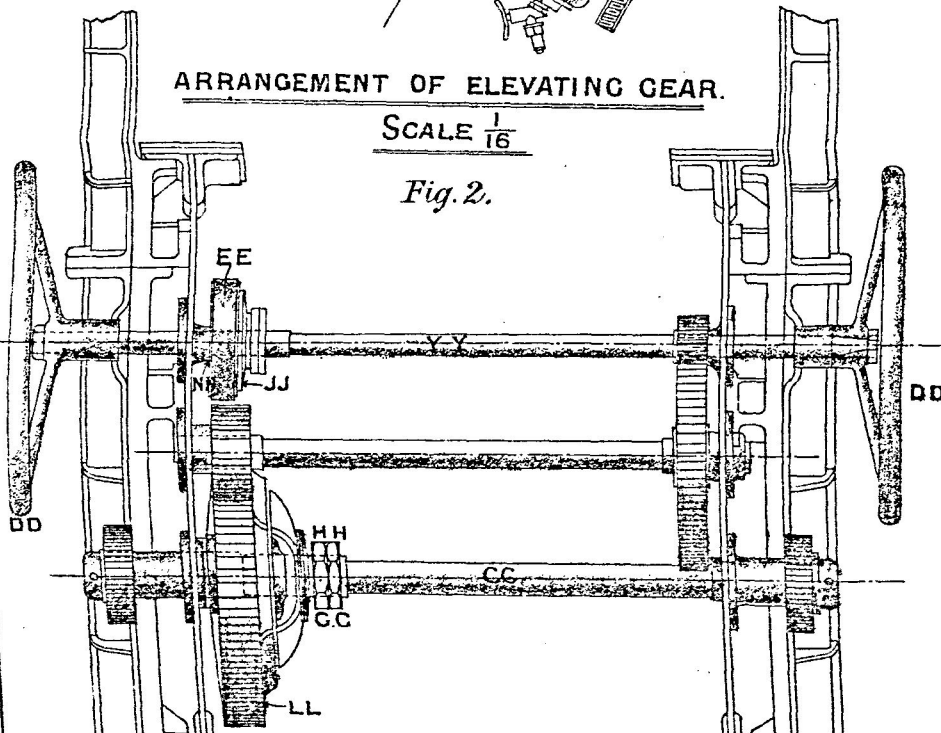
SCALE $\frac{1}{20}$



ARRANGEMENT OF ELEVATING GEAR.

SCALE $\frac{1}{16}$

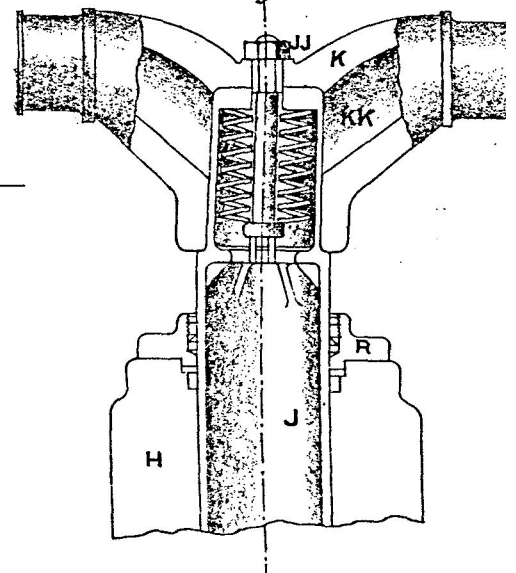
Fig. 2.



SECTION OF CROSSHEAD.

SCALE $\frac{1}{20}$

Fig. 1.



CARRIAGE, GARRISON, DISAPPEARING, B.L., 92-INCH MARK I

ADJUSTMENT OF VALVES (REFERRED TO AT PAGE 61)

Scale 3 Inches = 1 Foot

Fig. 1.

RAISING VALVE

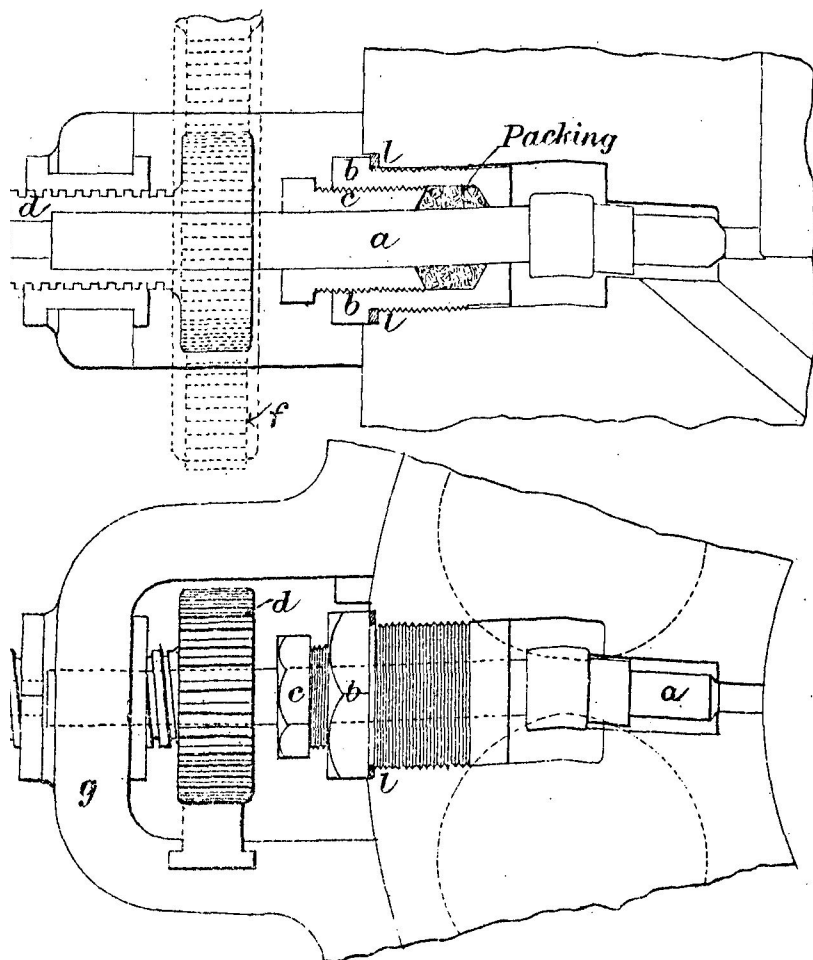
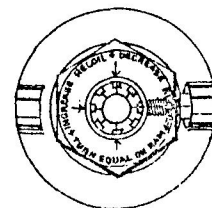
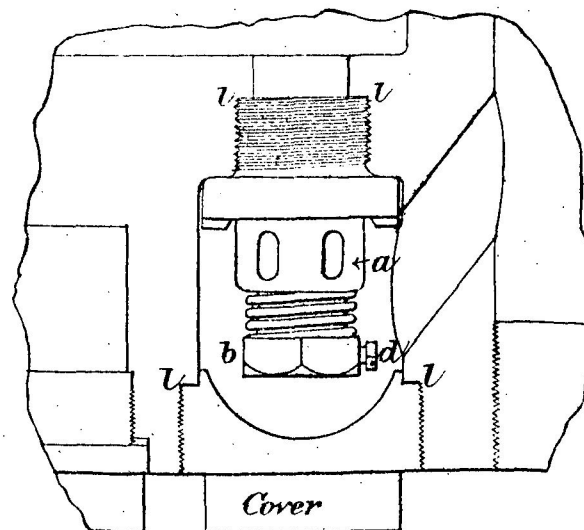


Fig. 2.

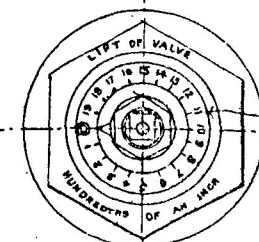
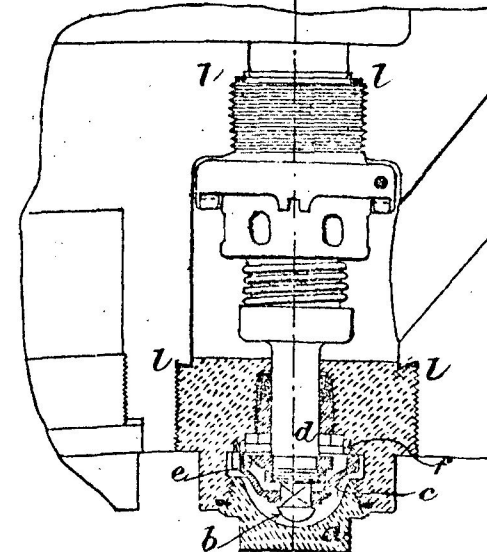
RECOIL VALVE, MARK I.



— PLAN —
Cover removed

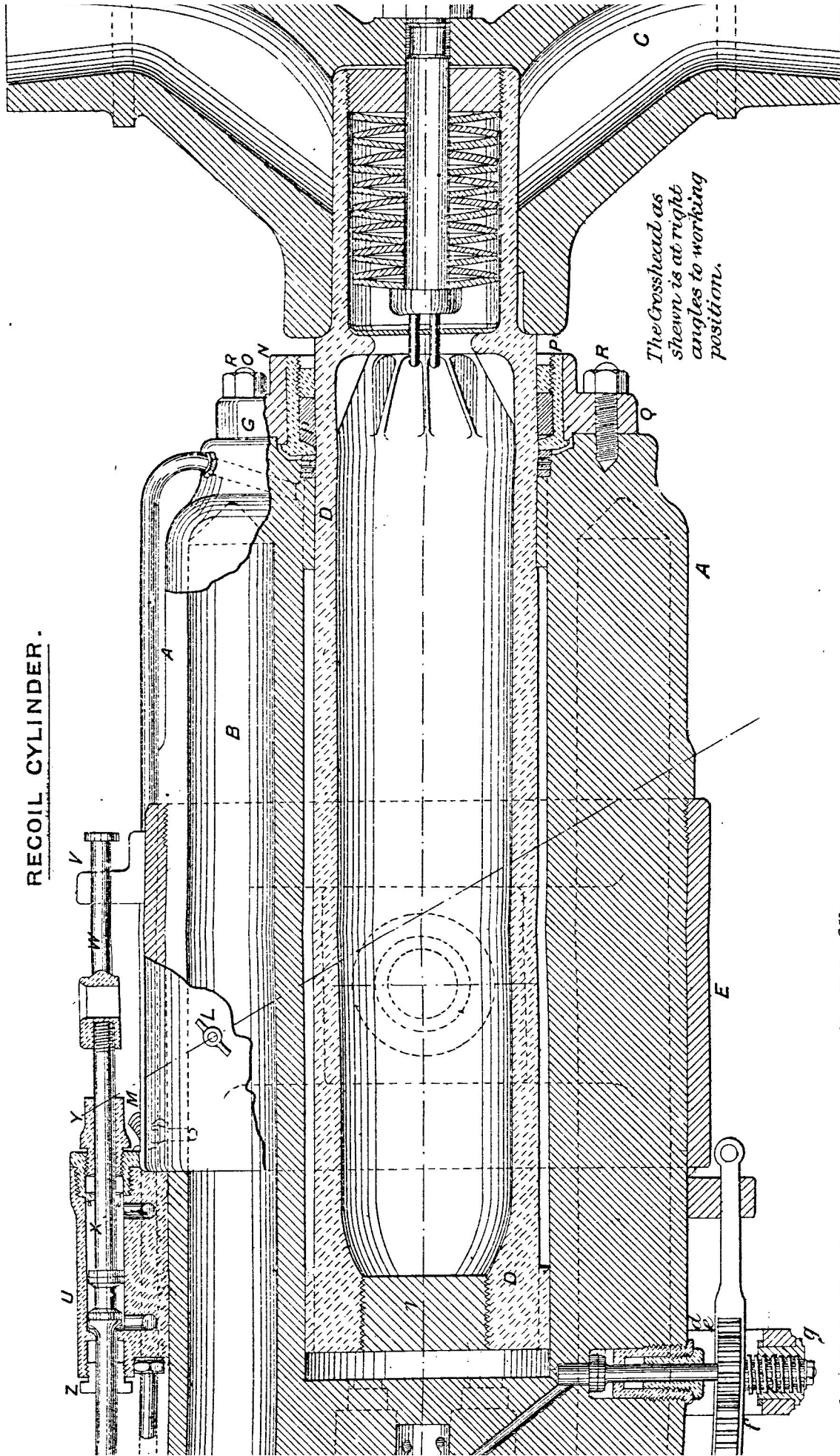
Fig. 3.

RECOIL VALVE, MARK II



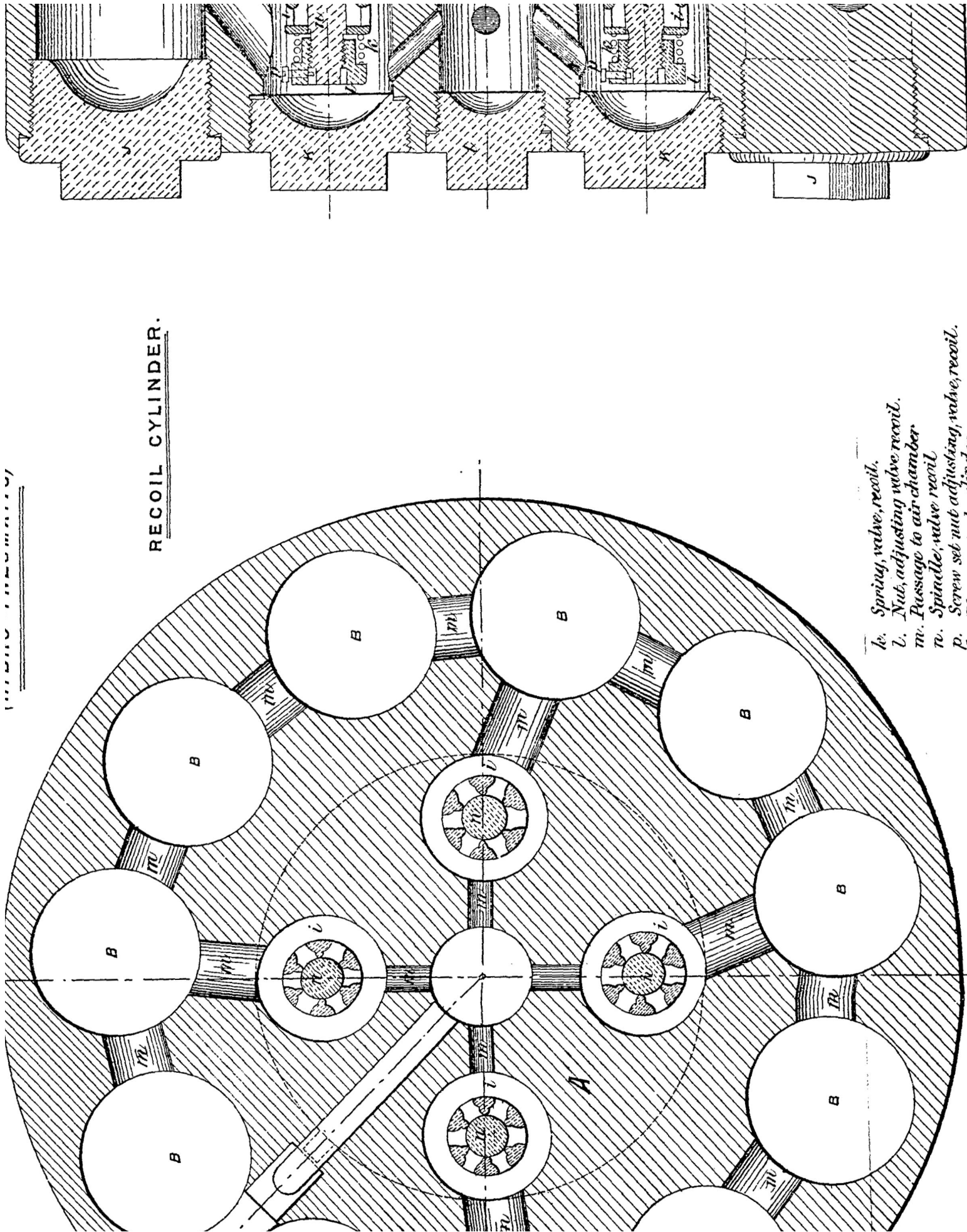
— PLAN —
with Stop Plate removed

RECOIL CYLINDER.



- | | | | |
|---|--------------------------------|---|-----------------------------|
| A | Cylinder, Recoil | Y | Gland, rod, piston, top, |
| B | Air Chamber | Z | " " " bottom, |
| C | Crosshead | a | Pipe suction |
| D | Rod | b | " delivery |
| E | Band, trunnion | c | Spindle, valve, raising |
| F | Bolt crosshead | d | Box, stuffing valve raising |
| G | Springs, ram. | e | Gland |
| H | Plug, ram, top | f | Pinion & screw |
| I | " " bottom | g | Nut screw |
| J | " air chamber | h | Rack |
| K | Cross valve recoil | | |
| M | Valve filling | | |
| N | Gland. | | |
| O | Ring, packing | | |
| P | Box, stuffing cylinder recoil. | | |
| Q | Cover, cylinder recoil. | | |
| R | Studs cover " " | | |
| S | Packings, Hydraulic | | |
| T | Rings packing | | |
| U | Pump, lowering | | |
| V | Bracket, guide, piston | | |
| W | Rod, guide, piston, rod | | |

RECOIL CYLINDER.

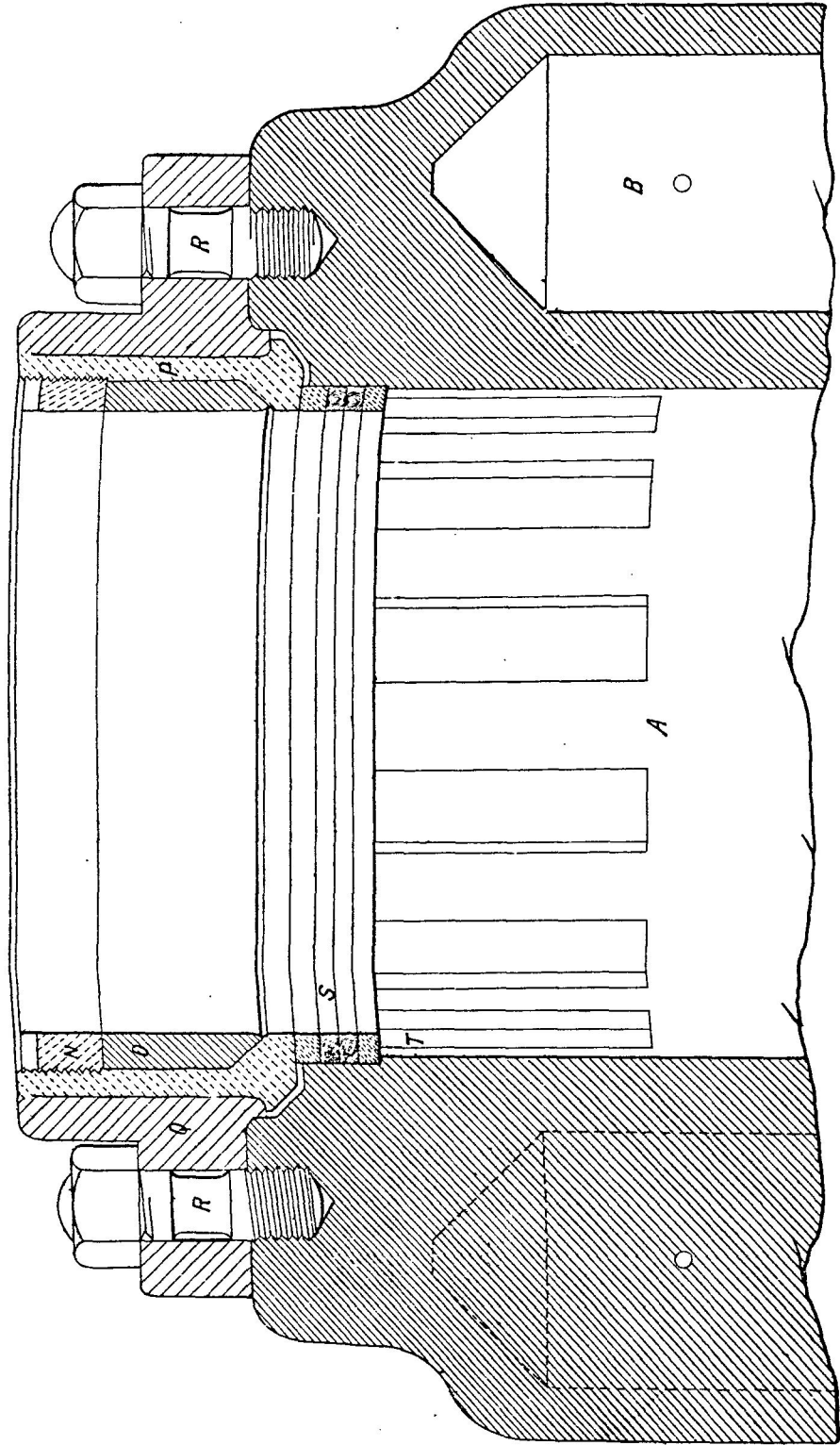


- h. Spring, valve, recoil.
- i. Nut, adjusting valve, recoil.
- m. Passage to air-chamber
- v. Spindle, valve, recoil
- p. Screw set nut adjusting, valve, recoil.

CARRIAGE, GARRISON, DISAPPEARING, B.L., 9.2 INCH, MARK I.

(HYDRO - PNEUMATIC.)

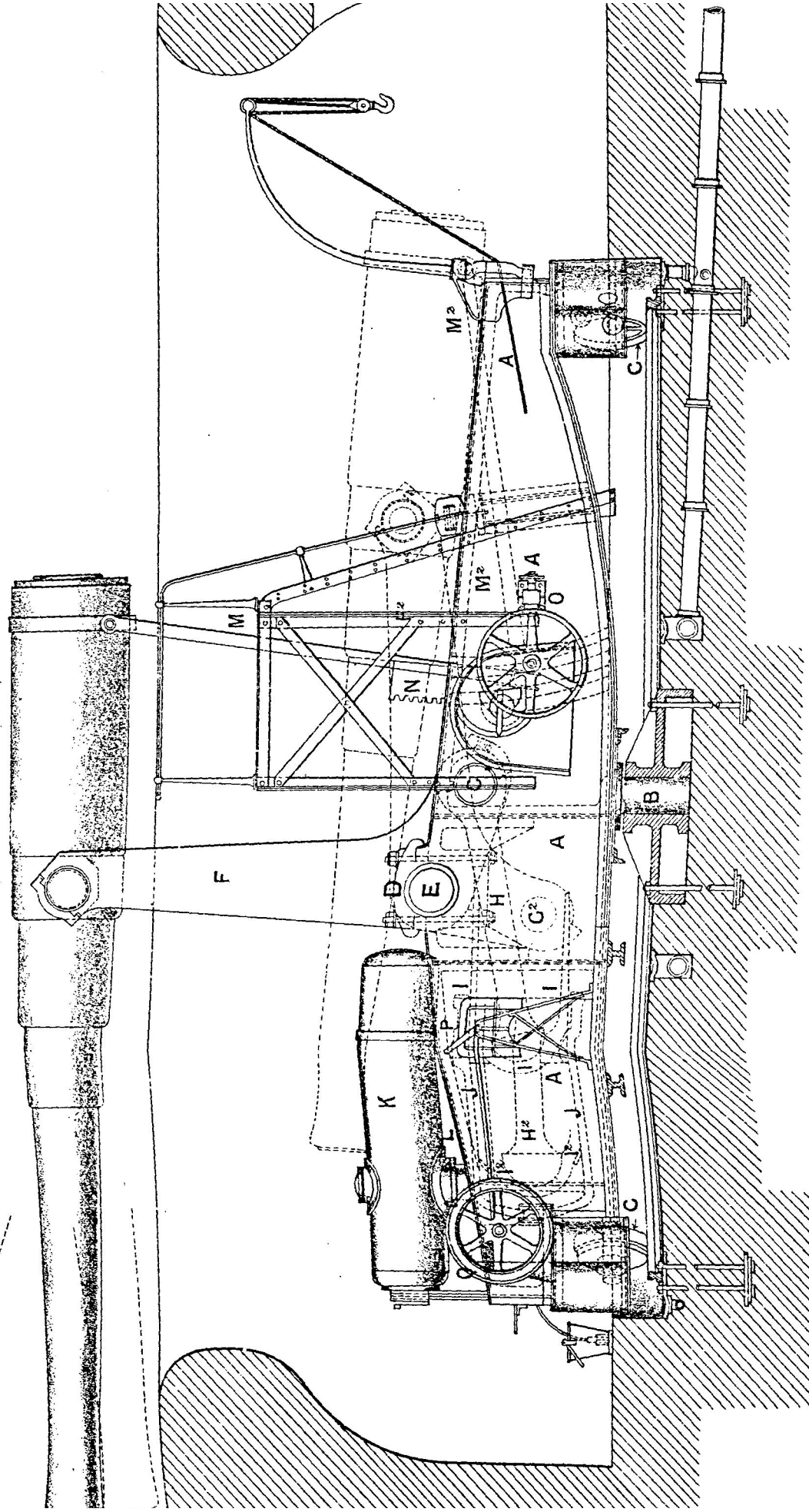
RECOIL CYLINDER.

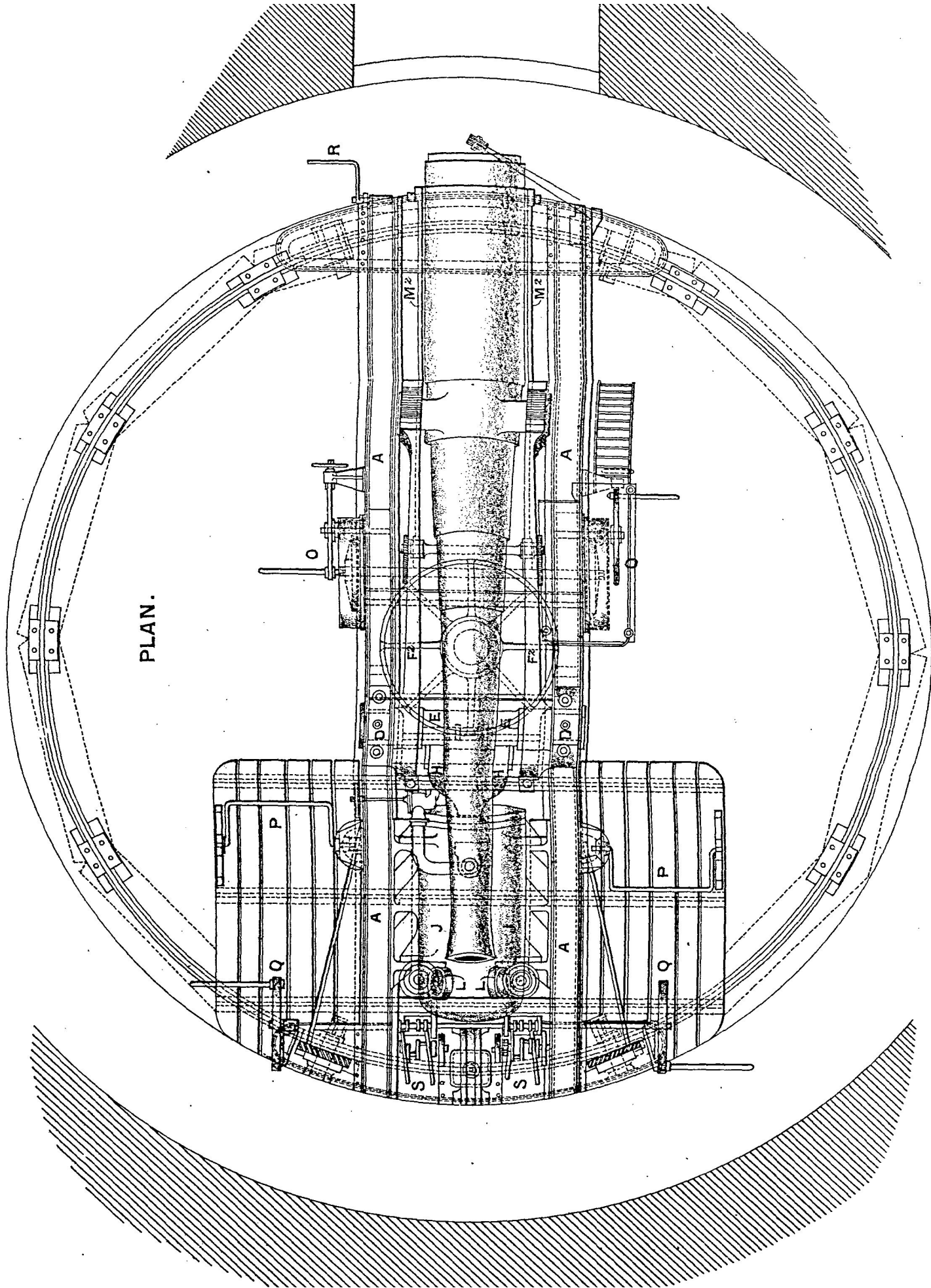


- | | |
|---|-------------------------------|
| A | Cylinder Recoil. |
| B | Air Chamber. |
| N | Gland. |
| O | Ring Packing |
| P | Box stuffing cylinder-recoil. |
| Q | Cover, Cylinder recoil. |
| R | Studs, Cover. |
| S | Packing, Hydraulic. |
| T | Hydraulic leather. |

CARRIAGE, CARRISON, B.L. DISAPPEARING, 9.2 INCH, MARK II.

ELEVATION.





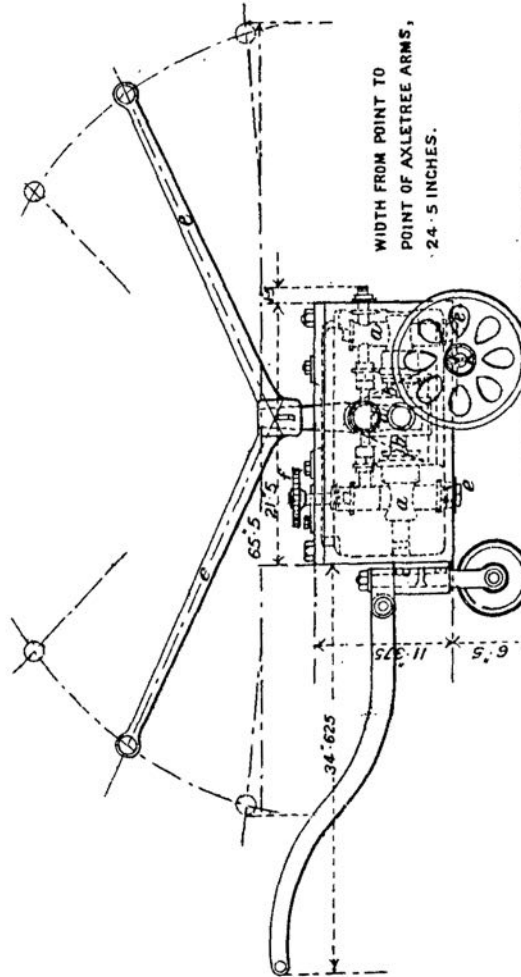
PLAN.

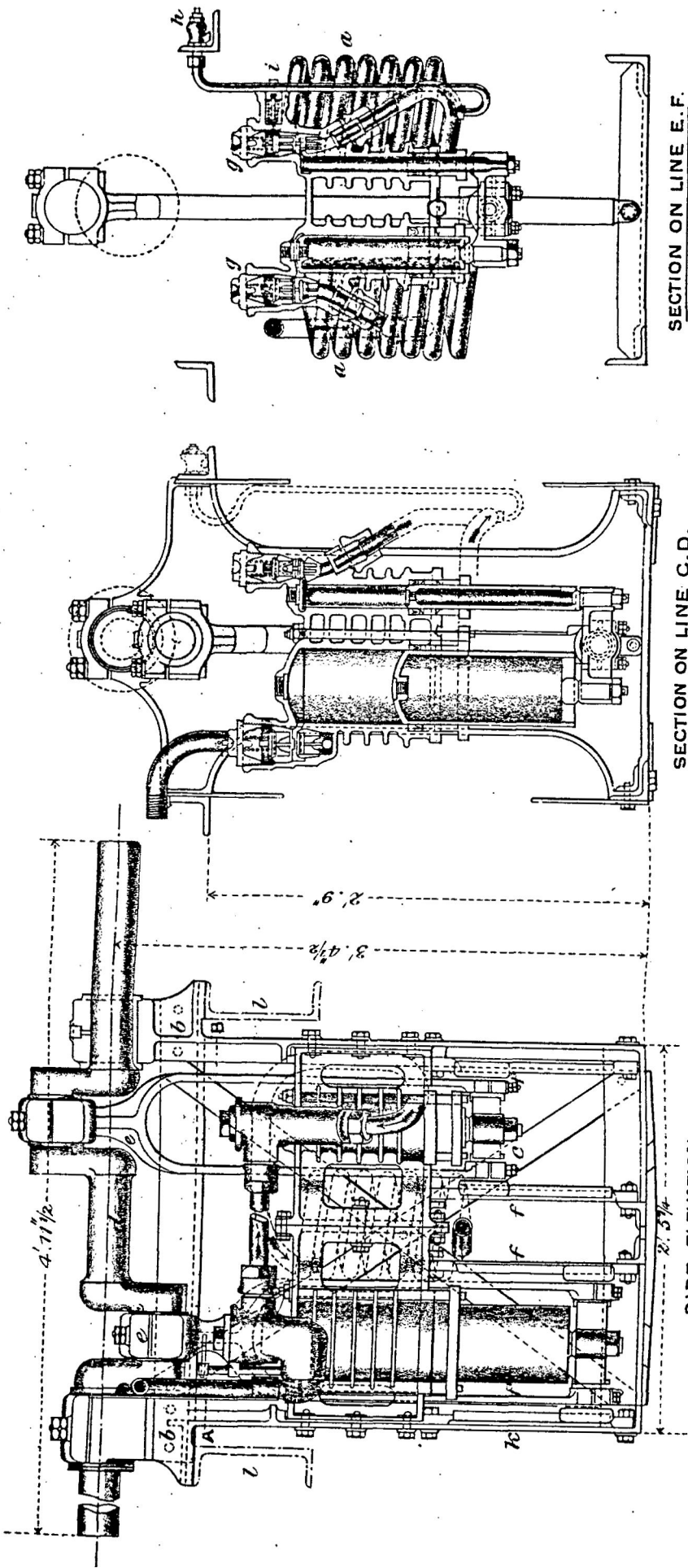
PUMP, RUNNING BACK, PORTABLE, MARK I.

CARRIAGES, GARRISON, B. L., 12-INCH, AND

9·2 INCH, MARKS III, IV, & V BARBETTE.

SCALE $\frac{1}{16}$

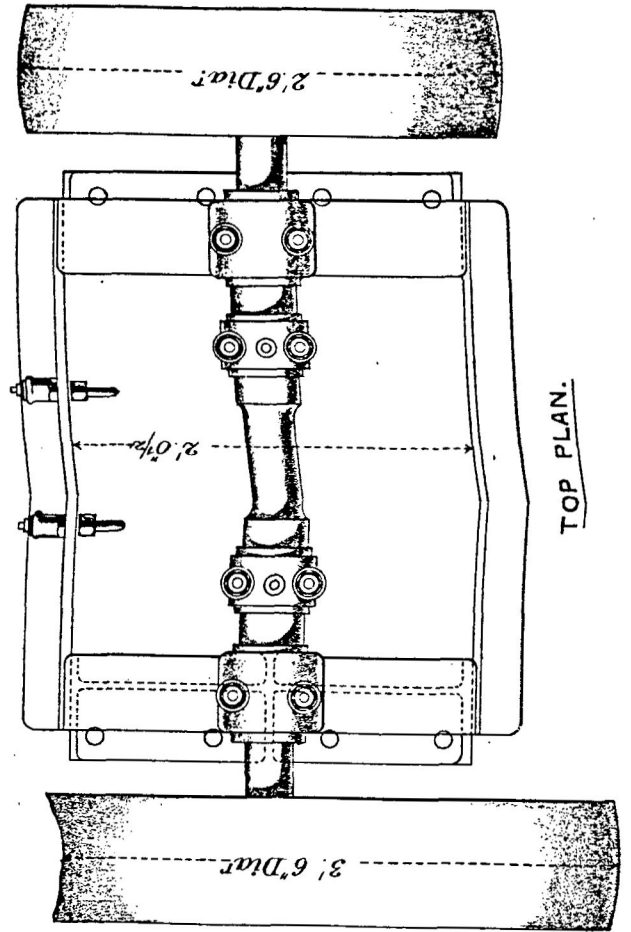




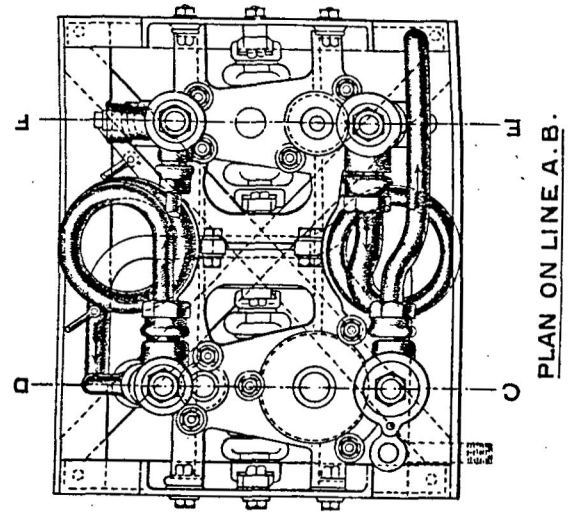
SECTION ON LINE E.F.

SECTION ON LINE C.D.

SIDE ELEVATION.



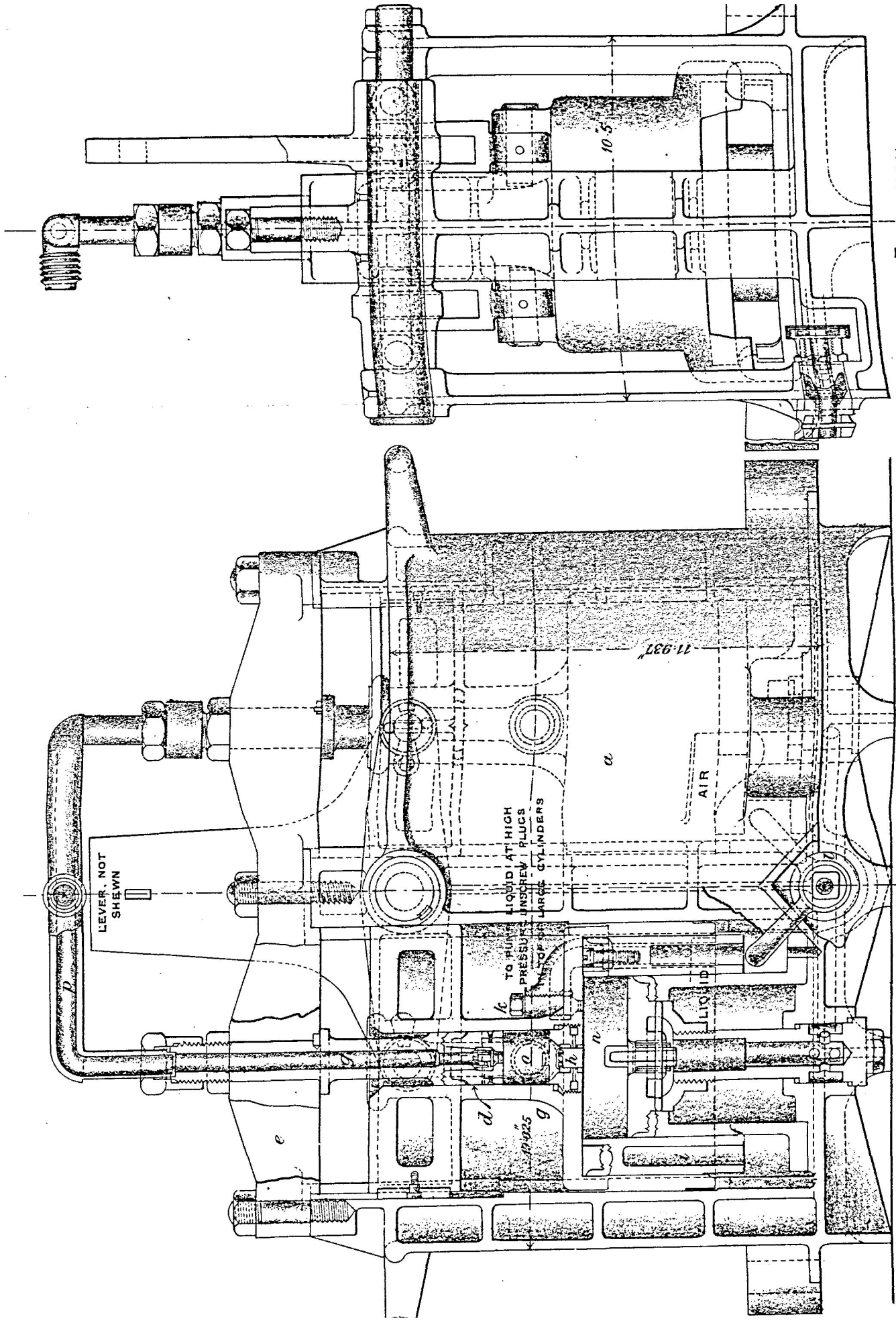
TOP PLAN.



PLAN ON LINE A.B.

PUMP, AIR OR LIQUID, MARK 1.

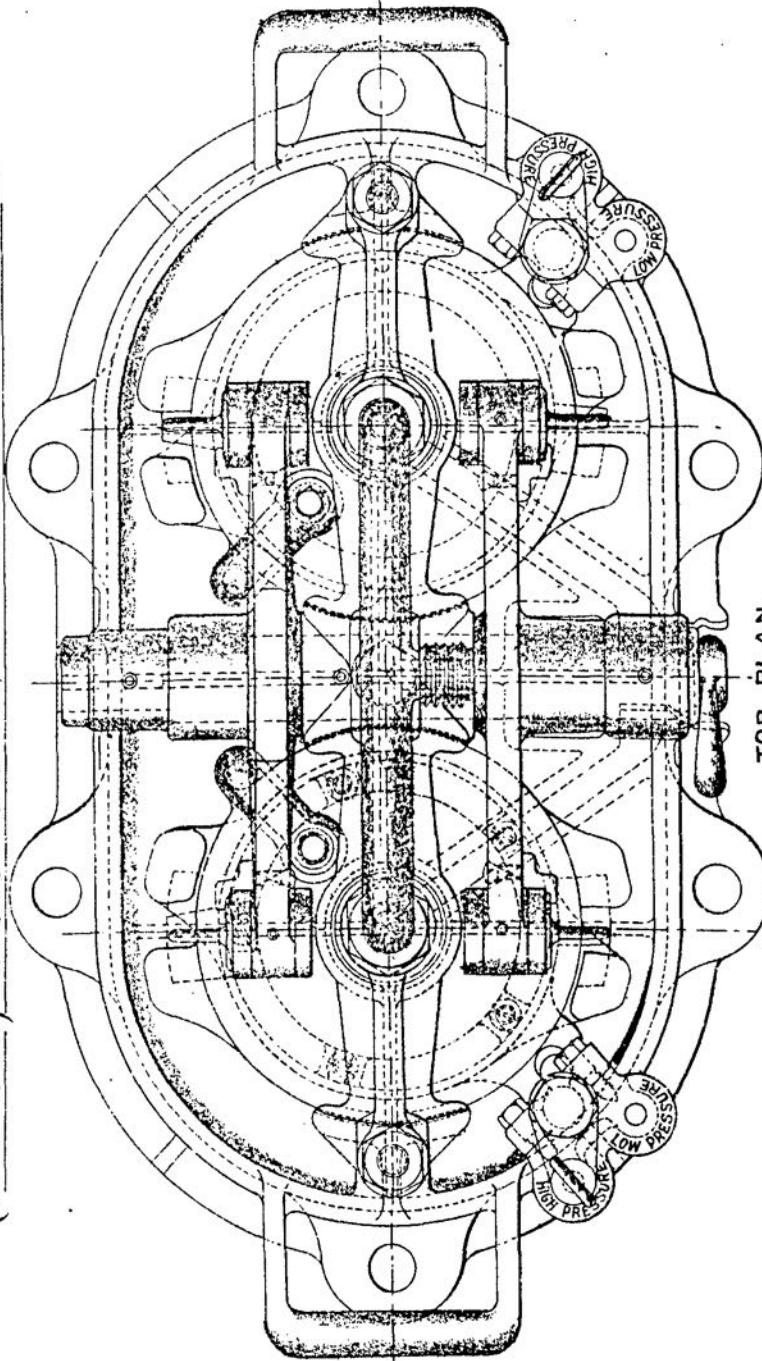
WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1 A AND 3 B) AND 4 SPANNERS (Nos 157 TO 160;) CHARGING RESERVOIRS, & HYDRO PNEUMATIC MOUNTINGS.



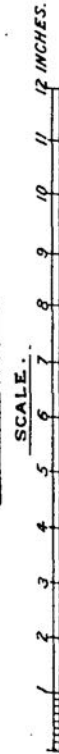
SIDE ELEVATION.

END ELEVATION.

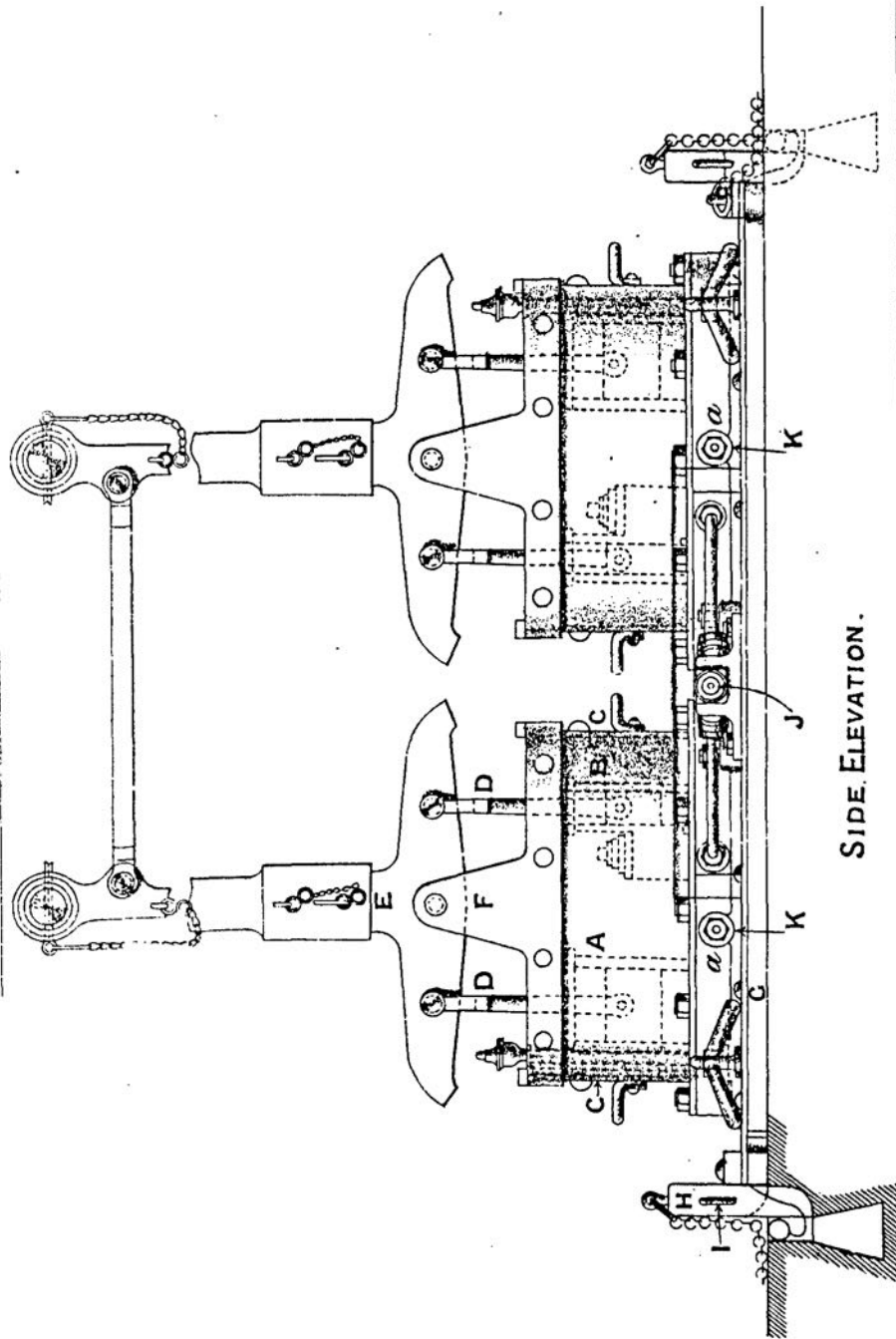
PUMP, AIR OR LIQUID, MARK I.
 WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1" A AND 3" B,) AND 4 SPANNERS.
 (Nos 157 TO 160.) CHARGING RESERVOIRS, AND HYDRO-PNEUMATIC MOUNTINGS.



TOP PLAN.

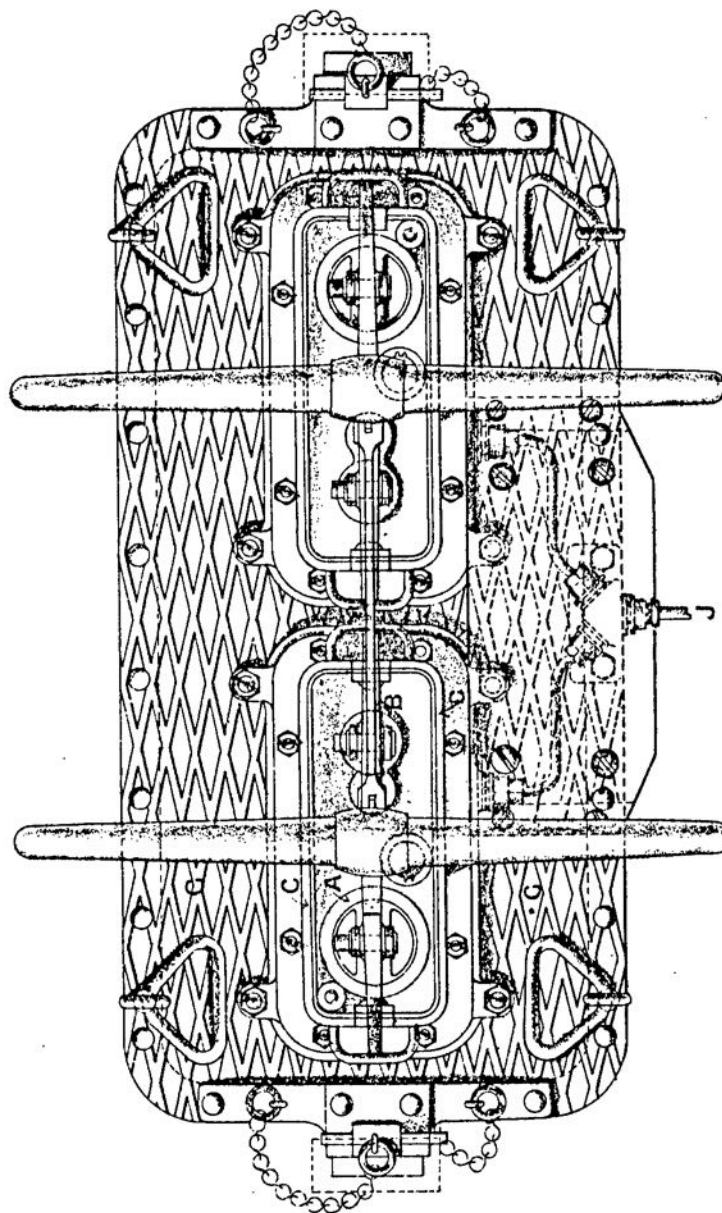


PUMP, AIR, DOUBLE, MARK I.



SIDE ELEVATION.

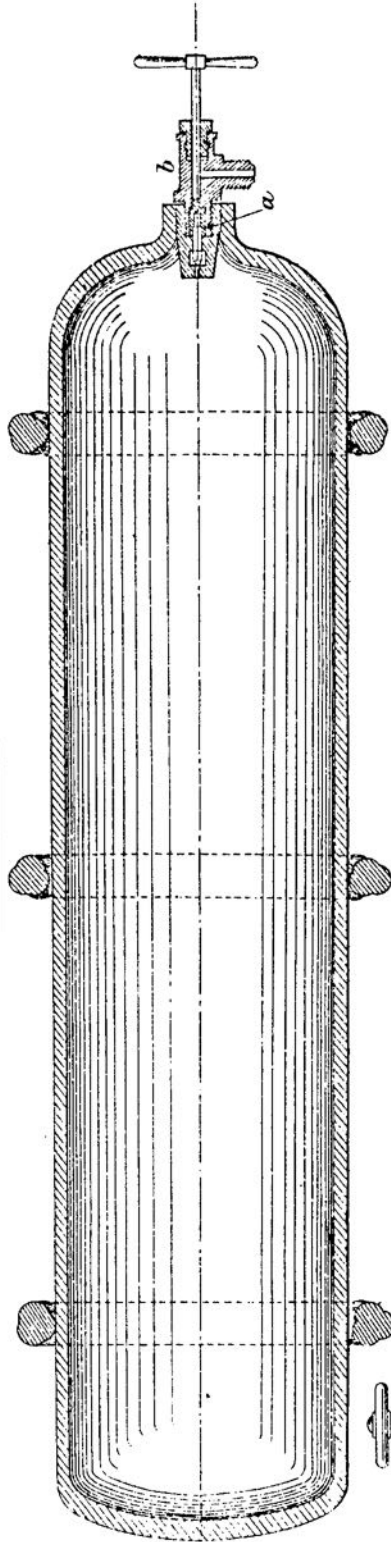
PUMP, AIR, DOUBLE, MARK I.



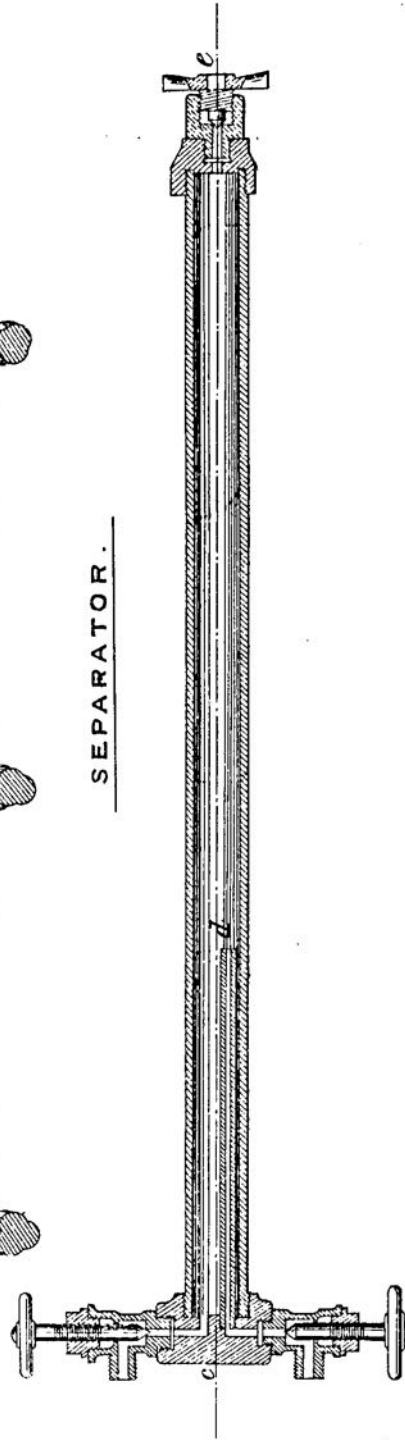
TOP PLAN.

RESERVOIR FOR COMPRESSED AIR.

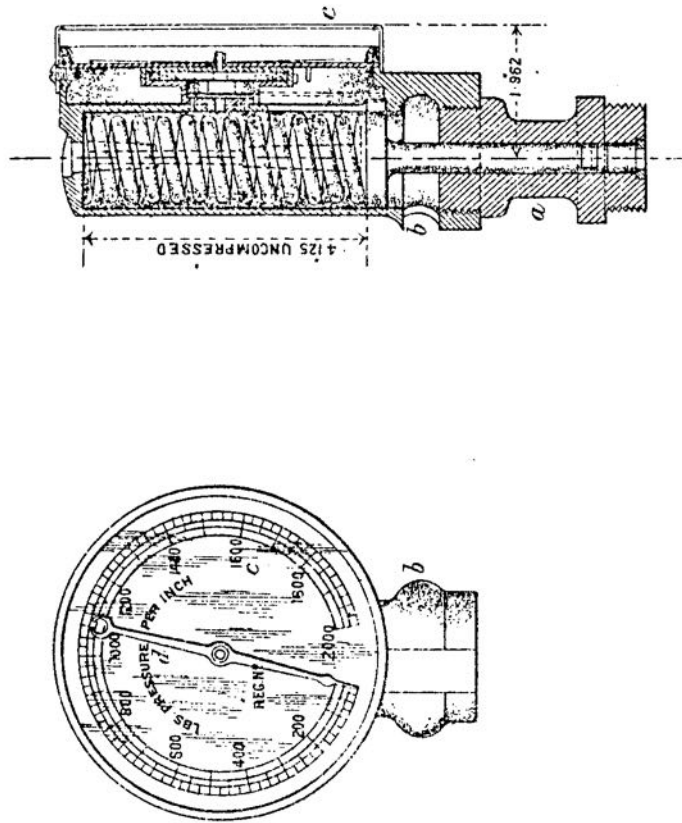
MARK II.



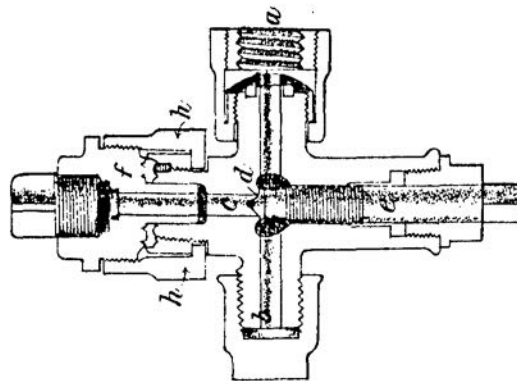
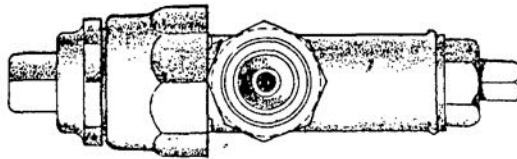
SEPARATOR.



INDICATOR, PRESSURE, SPRING.



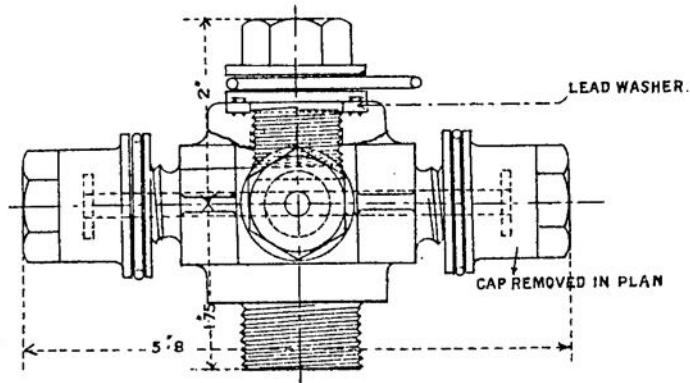
CONNECTION, INDICATOR, PRESSURE.



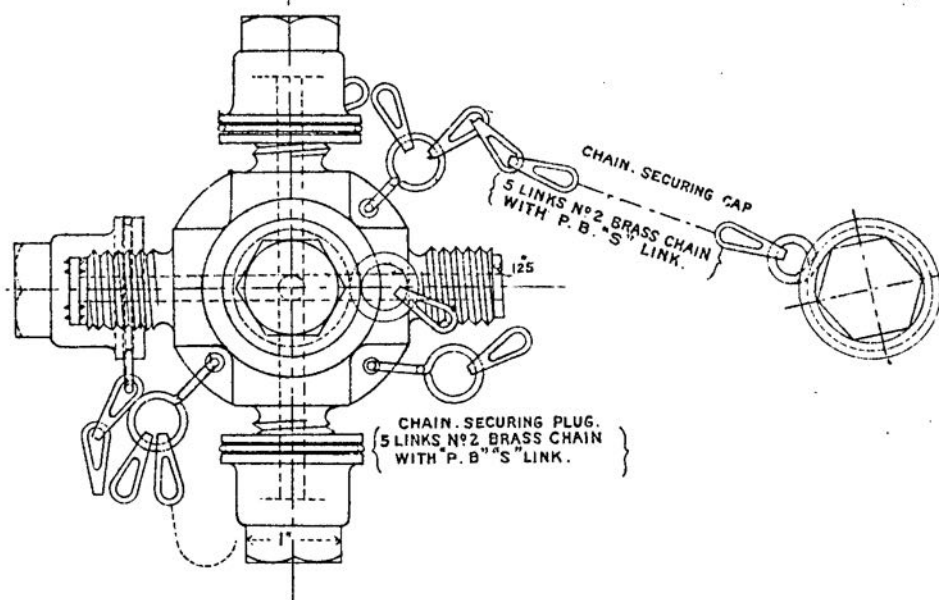
CONNECTION, FOUR-WAY, AIR PUMP, MARK I.

HALF FULL SIZE.

ELEVATION.



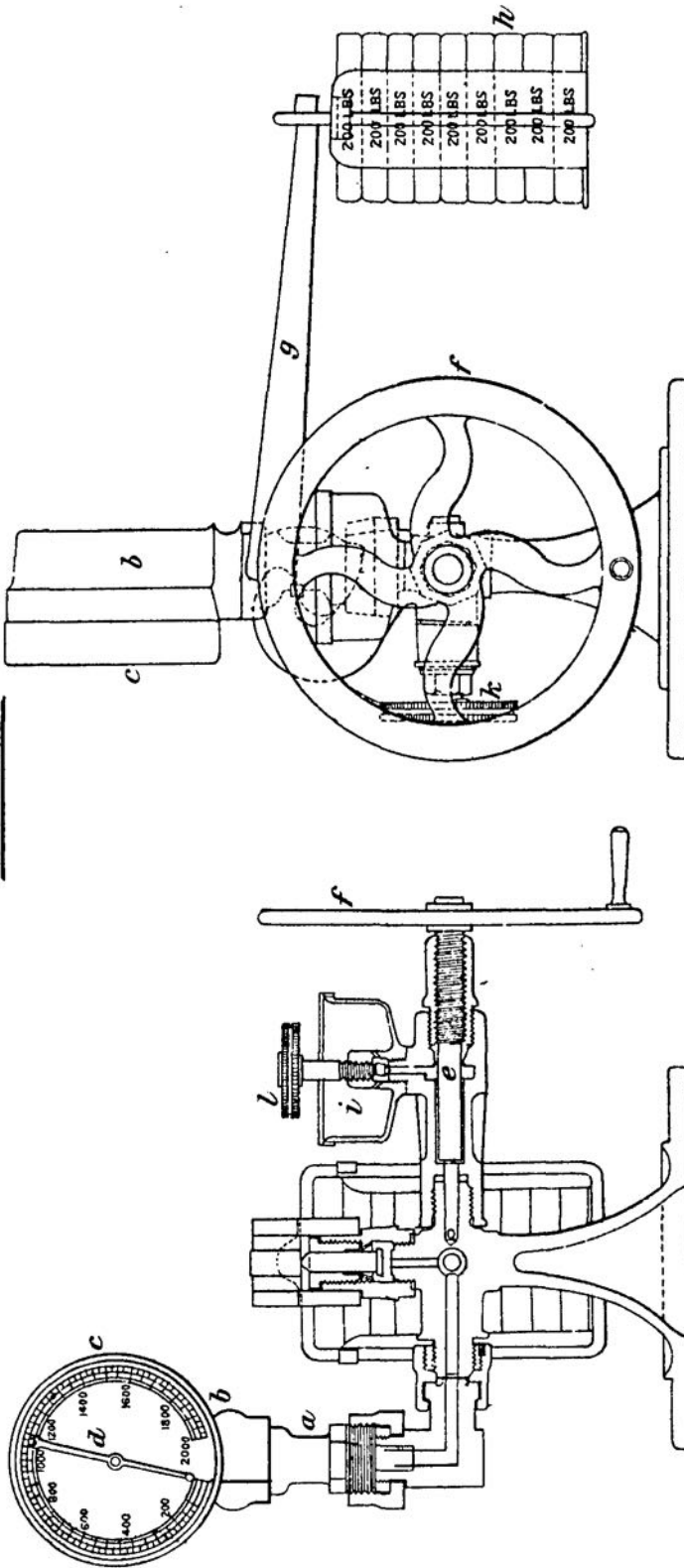
PLAN.



GAUGE, PRESSURE, DEAD WEIGHT, TESTING.

MARK II.

SCALE 1/4.

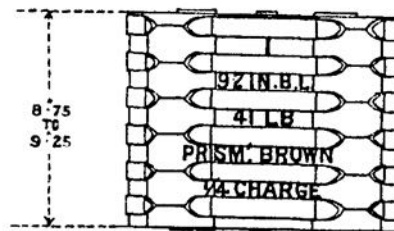


END ELEVATION.

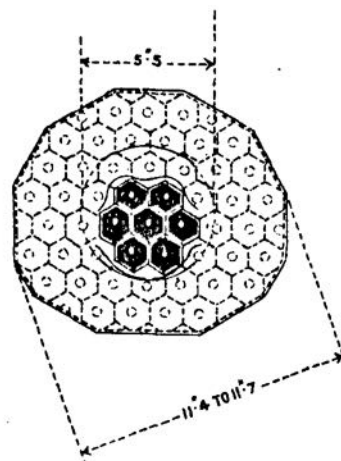
SECTIONAL ELEVATION.

CARTRIDGE, B.L., 92 INCH, 41 LB., PRISM; BROWN
LK CLOTH 1/4 CHARGE, PRIMED WITH PRISM BLACK, FULL
MARKS III. IV & V GUNS)

SCALE 1/8.



ELEVATION.

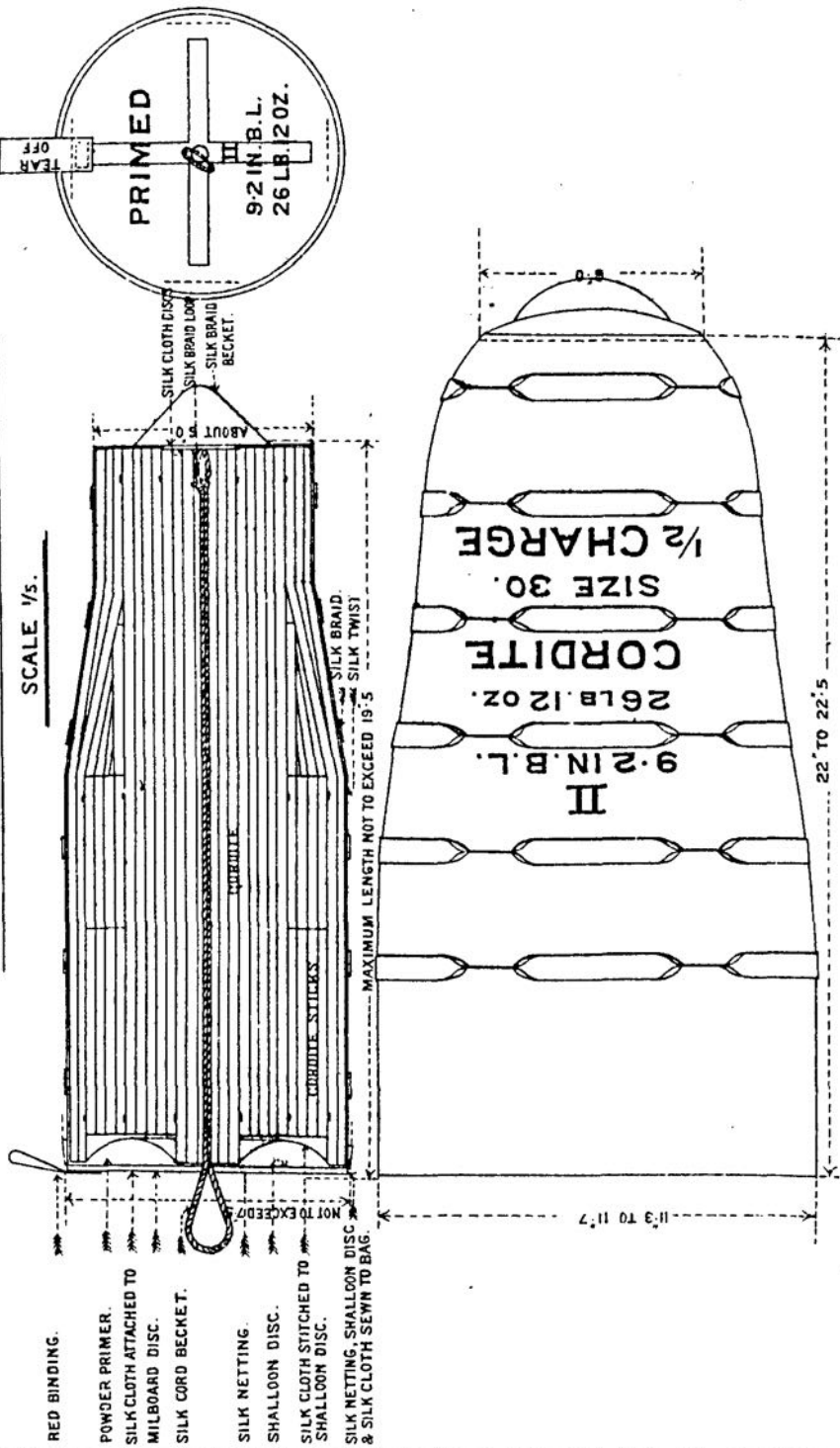


PLAN.

WITH PART OF TOP REMOVED.

CARTRIDGE, B. L., 9.2 INCH, 26 LB. 12 OZS., CORDITE, SIZE 30, MARK II.

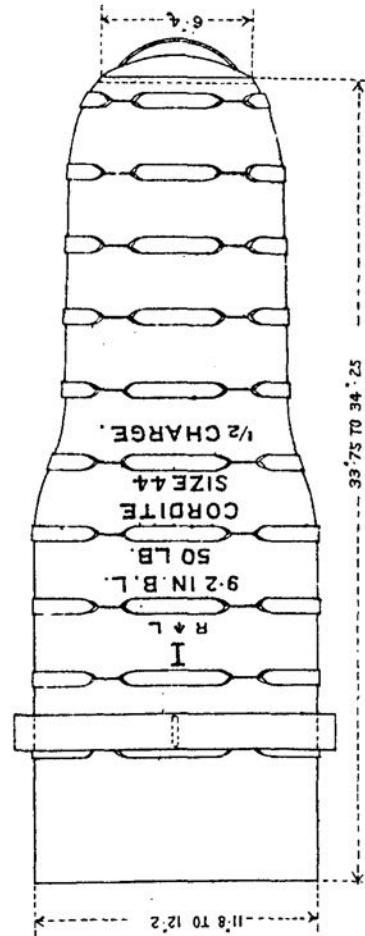
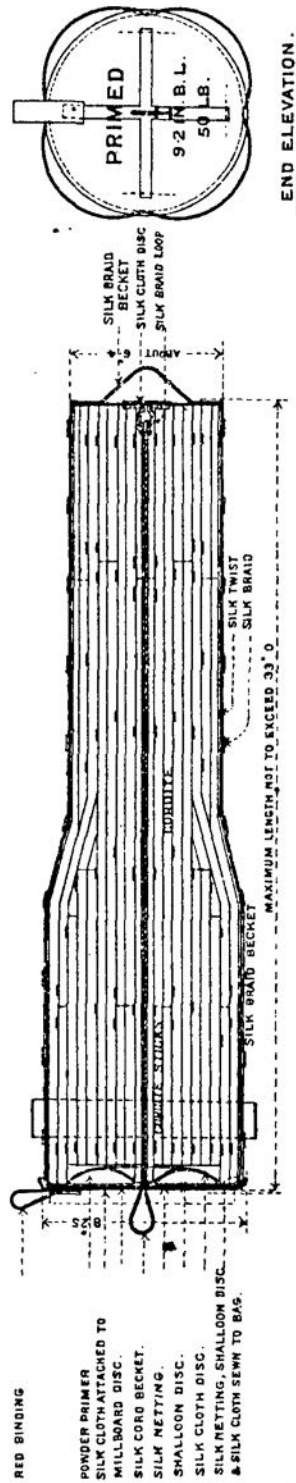
SILK CLOTH, HALF CHARGE: FOR MARKS III TO VII GUNS.



CARTRIDGE, B. L., 9.2 INCH, 50 LB, CORDITE, SIZE 44, MARK I.

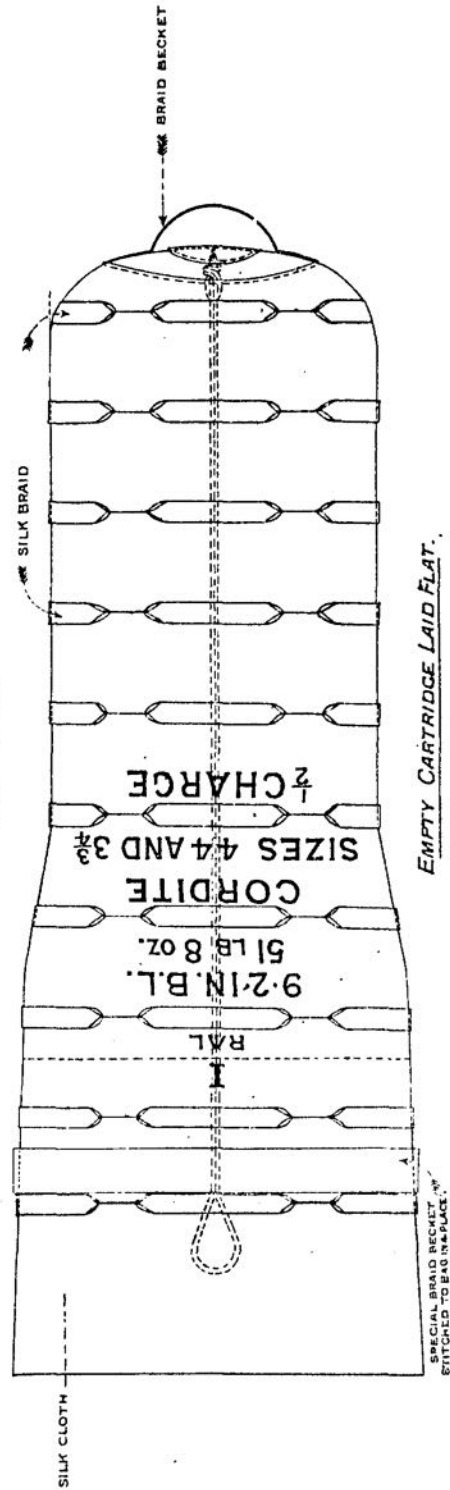
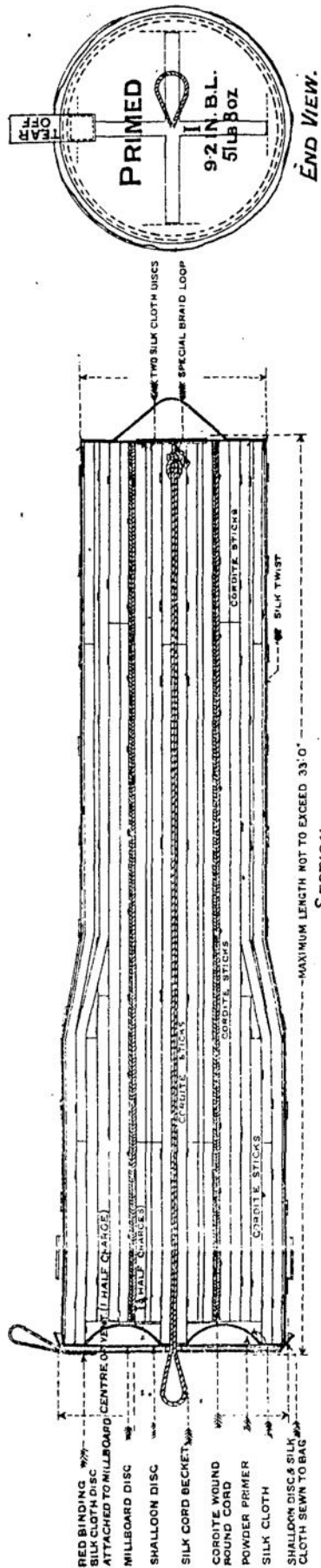
SILK CLOTH 1/2 CHARGE FOR MARK II WIRE GUNS.

SCALE 1/8.



CARTRIDGE, B.L., 9.2 INCH, 51 LB. 8 OZS., CORDITE SIZES 44 & 3 3/4, MARK I.
SILK CLOTH, 49 LB. 8 OZ. SIZE 44, & 2 LB. SIZE 3 3/4, 1/2 CHARGE, MARKS IX & X GUNS.

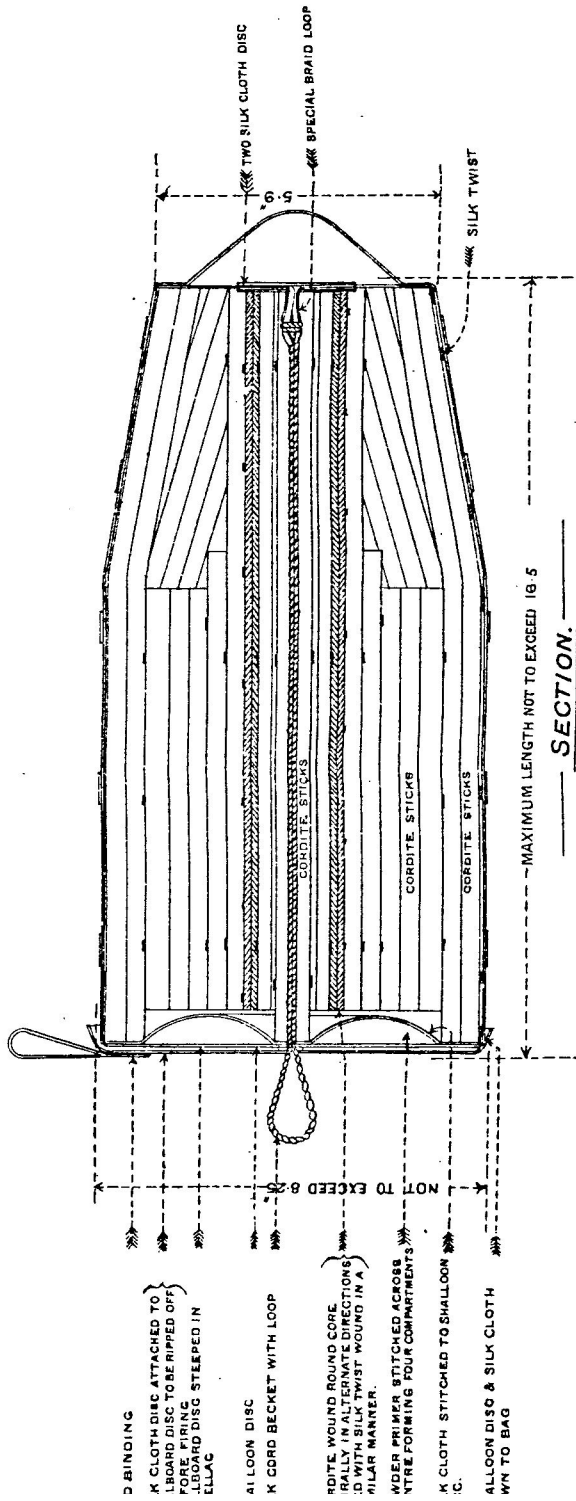
SCALE 1/6.



CARTRIDGE, D.L.V. INCH, 12 OZ. CARTRIDGE SIZES 44 & 374, MARK 1.

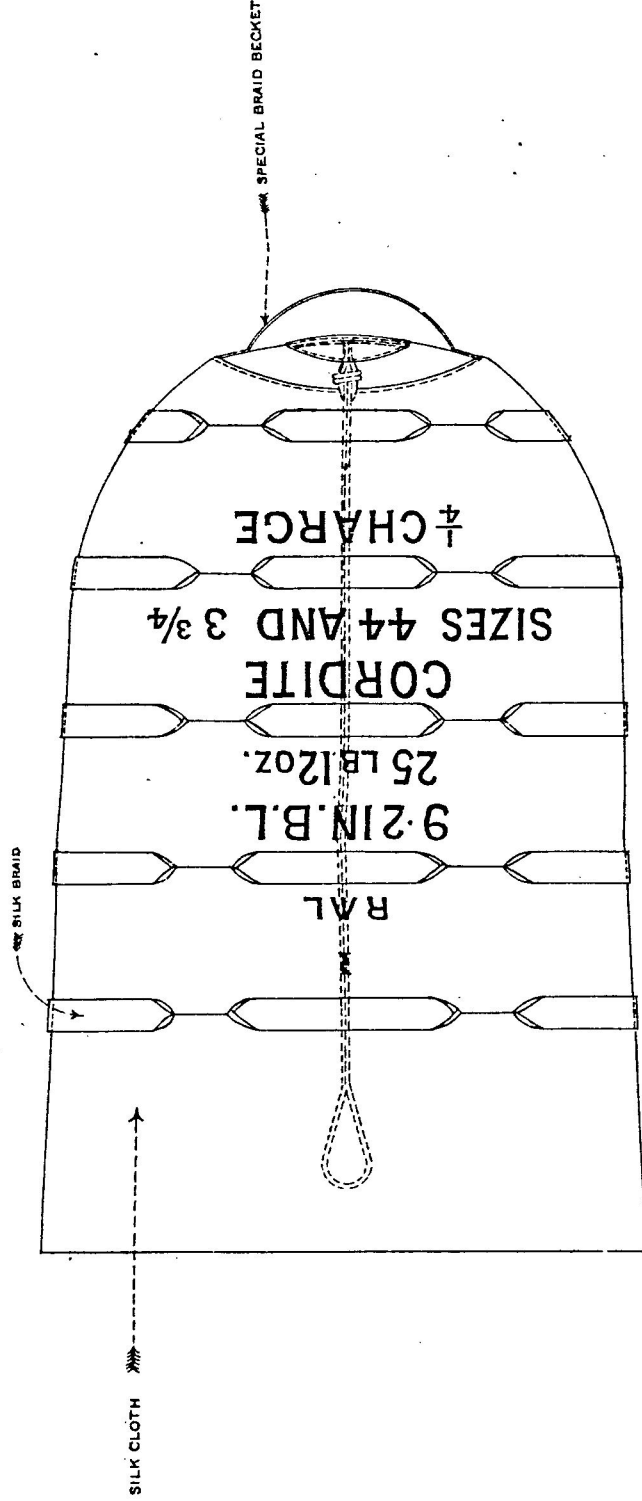
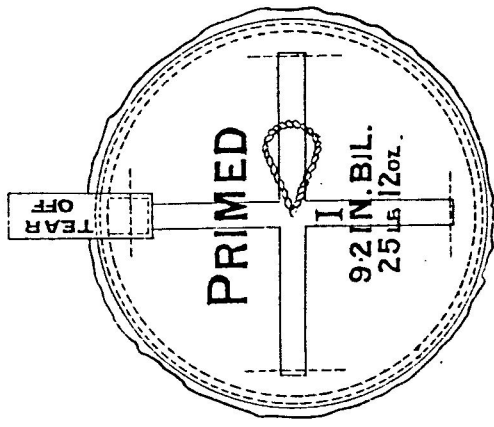
SILK CLOTH, 24-LB. 12 OZ. SIZE 44 & 1 LB SIZE 374, 1/4 CHARGE. MARKS IX & X GUNS.

SCALE 1/4



SECTION.

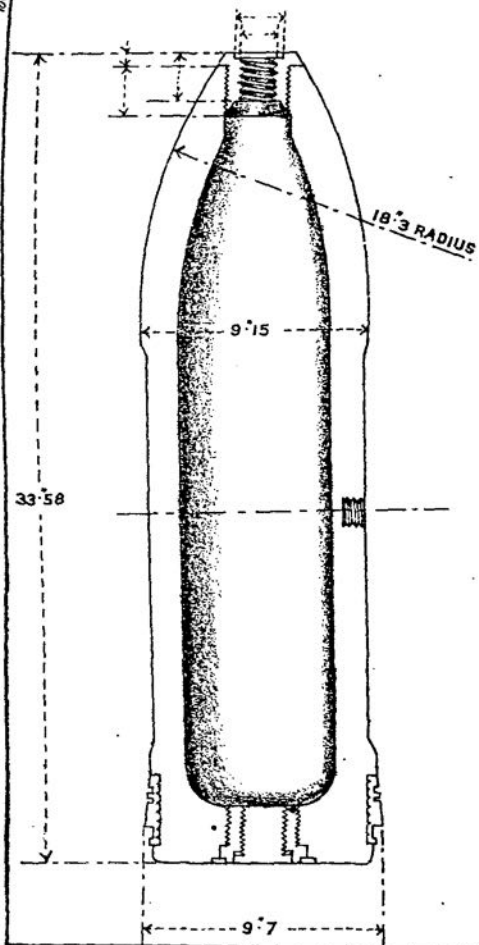
END VIEW



EMPTY CARTRIDGE LAID FLAT.

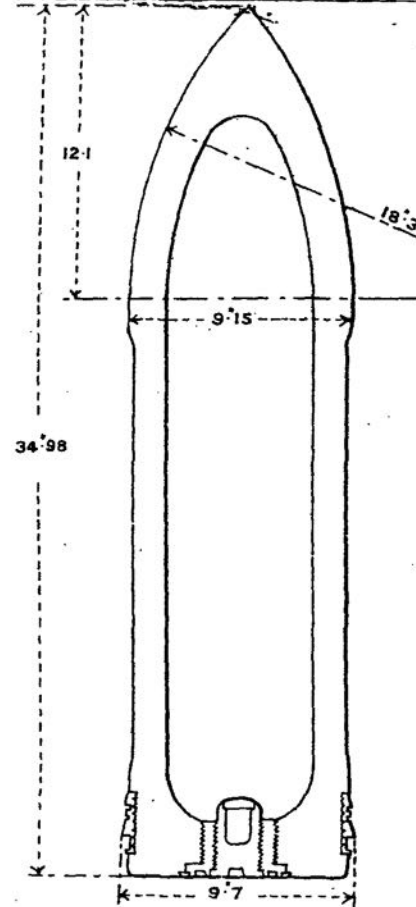
7.5.1909

COMMON, CAST STEEL, MARK V.

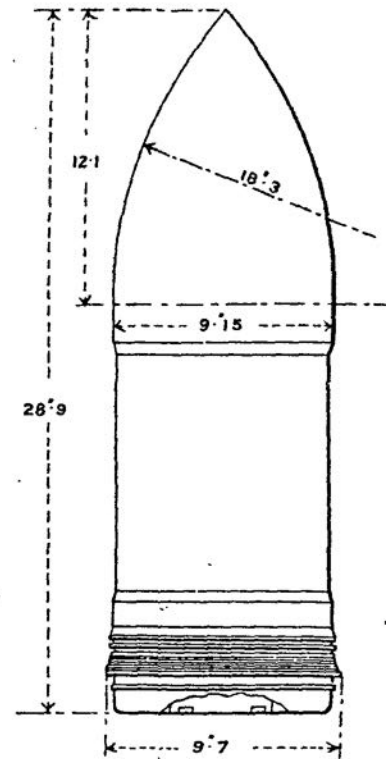


SCALE 1/8.

COMMON, POINTED, MARK II.



SHOT, ARMOUR-PIERCING.



E. Weller & Grahams, Ltd. Litho. London.

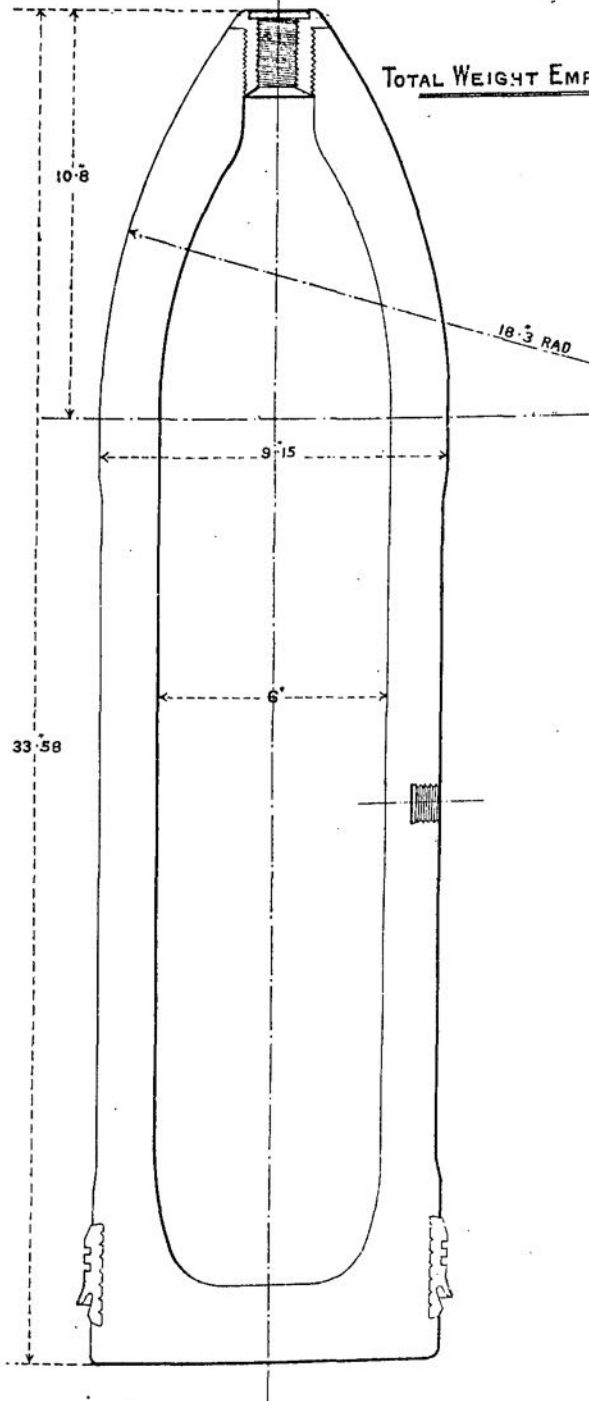
Plate XLIII

SHELL, B. L., LYDDITE, COMMON, 9.2 INCH (MARK II.) | L. |

FORGED STEEL.

SCALE 1/5.

TOTAL WEIGHT EMPTY. ^{LB.} 339. ^{OZ.} 6.



12.7.5.1901.

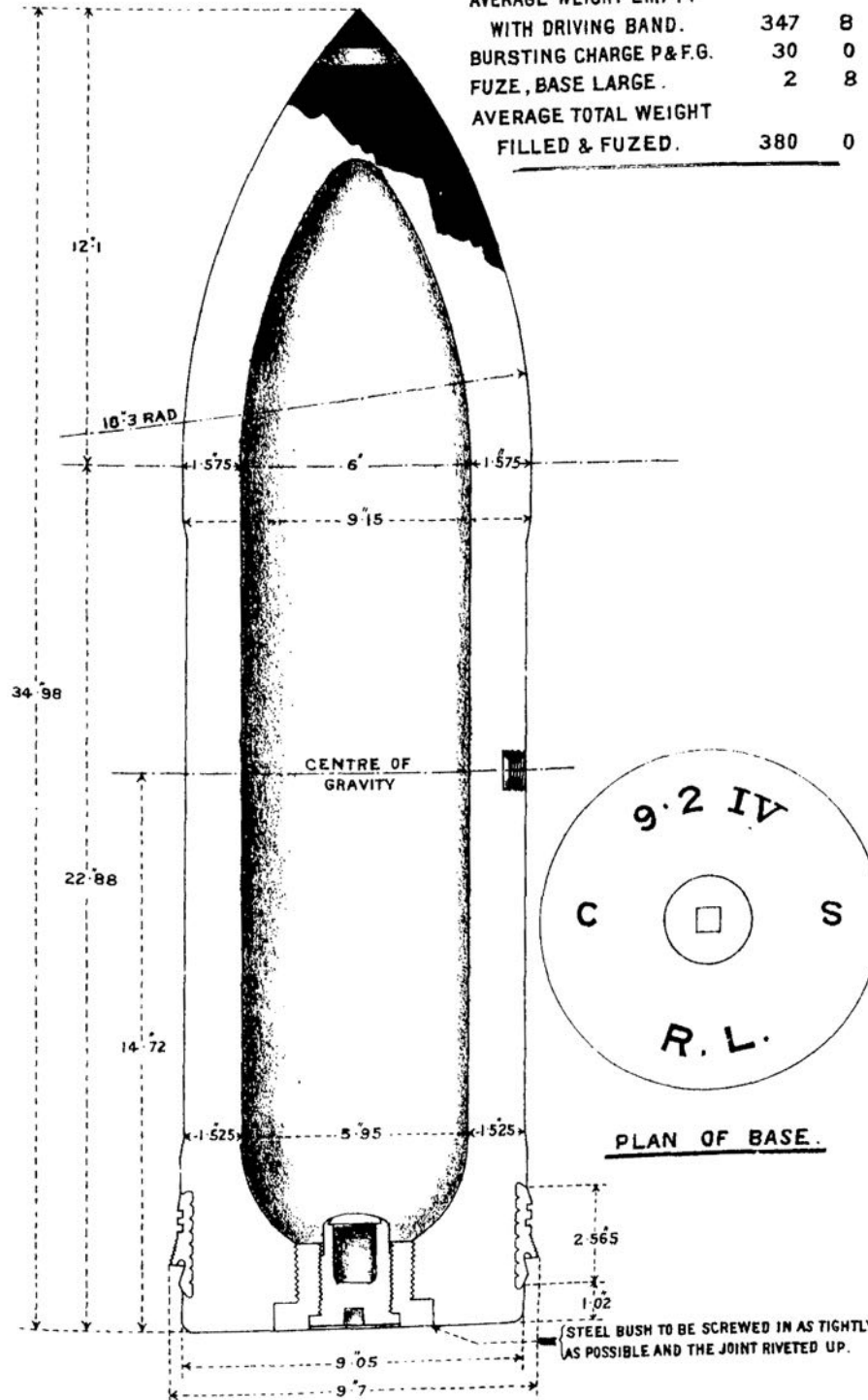
E. Weller & Grahams, Ltd Litho. London.

SHELL, B. L., COMMON POINTED, 9.2 IN., MARK V.

CAST STEEL; FOR LARGE BASE FUZE.

SCALE 1/5.

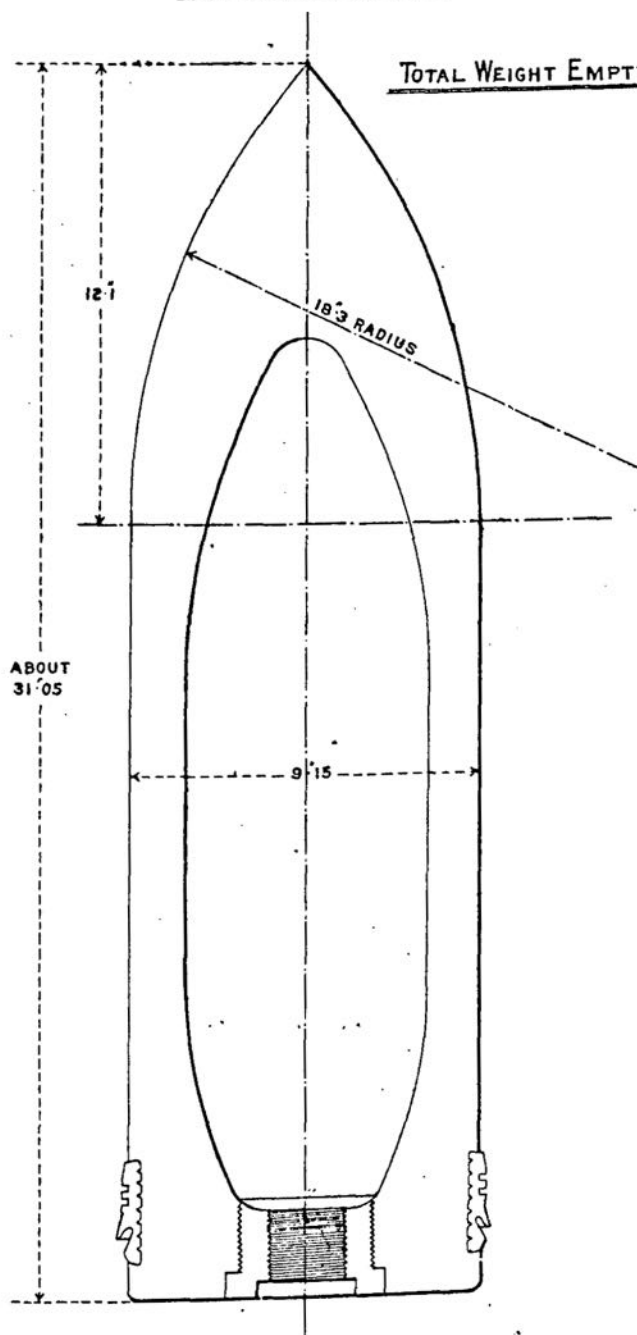
	LB.	OZ.
AVERAGE WEIGHT EMPTY		
WITH DRIVING BAND.	347	8
BURSTING CHARGE P&F.G.	30	0
FUZE, BASE LARGE.	2	8
AVERAGE TOTAL WEIGHT		
FILLED & FUZED.	380	0



SHELL, B.L. ARMOUR PIERCING, 9.2 INCH. (MARK II). [C.]
STEEL; FOR LARGE BASE FUSE.

SCALE 1/5.

TOTAL WEIGHT EMPTY. 359 ^{LB} ⁸ _{oz.}



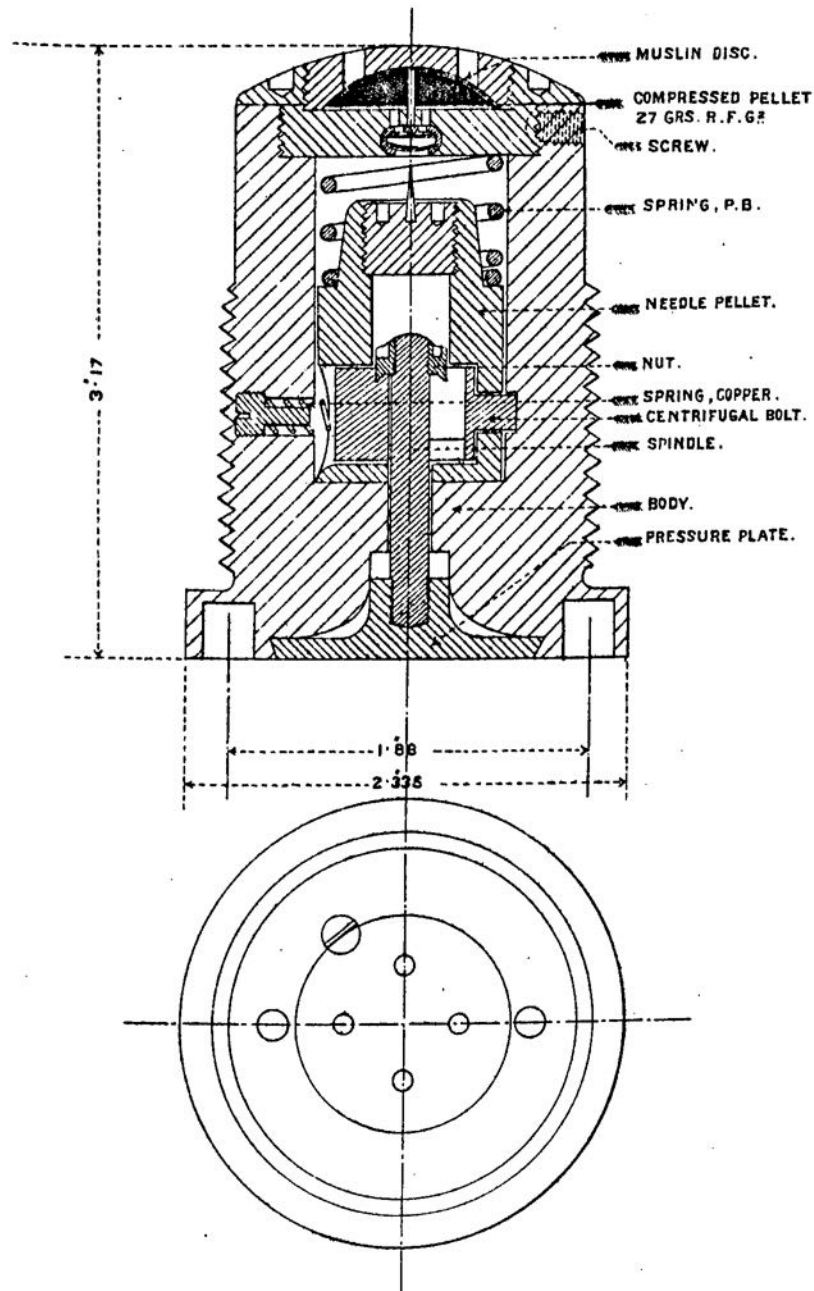
1237 S. 1901

E. Weller & Grahams, Ltd. Litho. London.

FUZE, PERCUSSION, BASE, LARGE, N° II, MARK II.

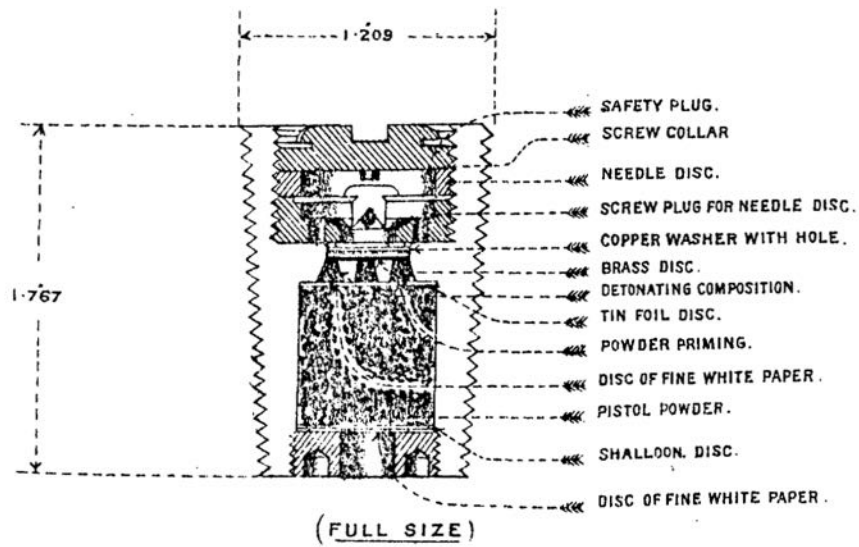
METAL ONE IN A TIN CYLINDER.

FULL SIZE.

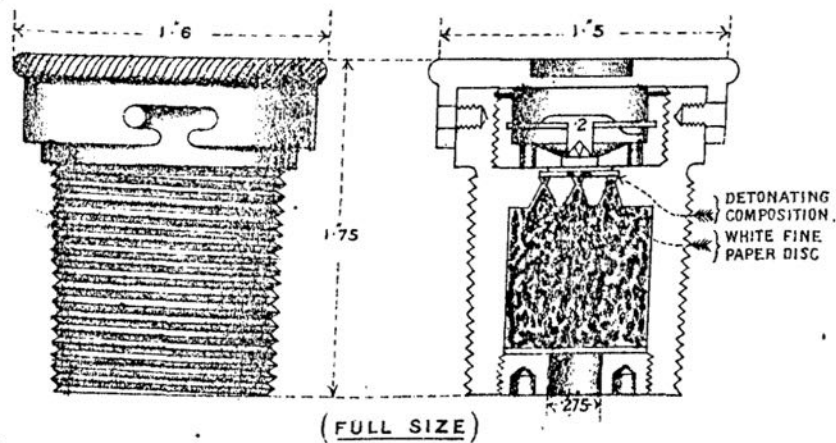


FUZE, PERCUSSION, DIRECT ACTION.

WITH PLUG, N° 3, MARK III.

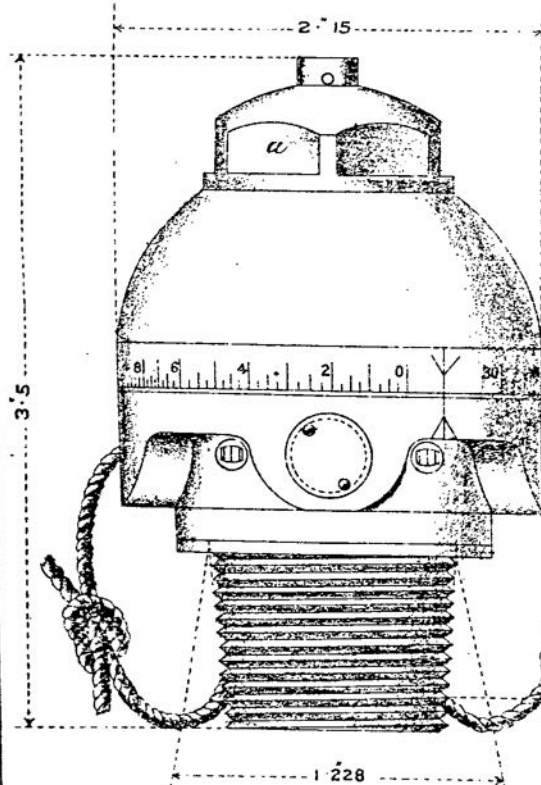


WITH CAP, N° 1, MARK II.

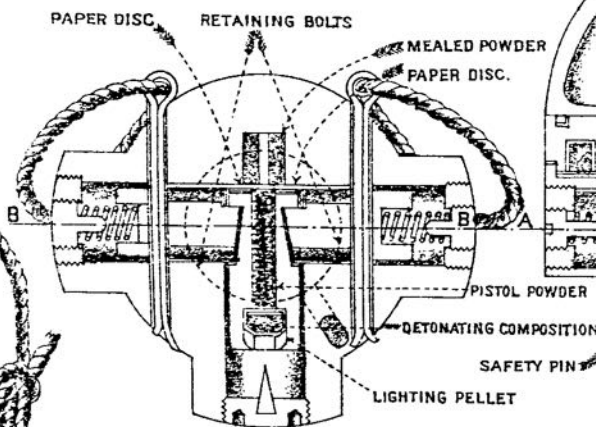


FUZE, TIME, SENSITIVE MIDDLE, N° 24, MARK I.

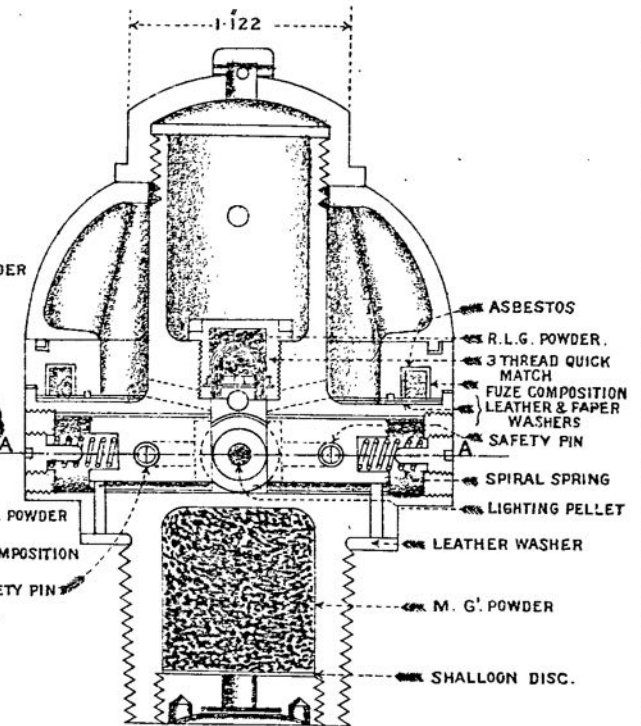
FULL SIZE.



ELEVATION SET AT SAFETY.



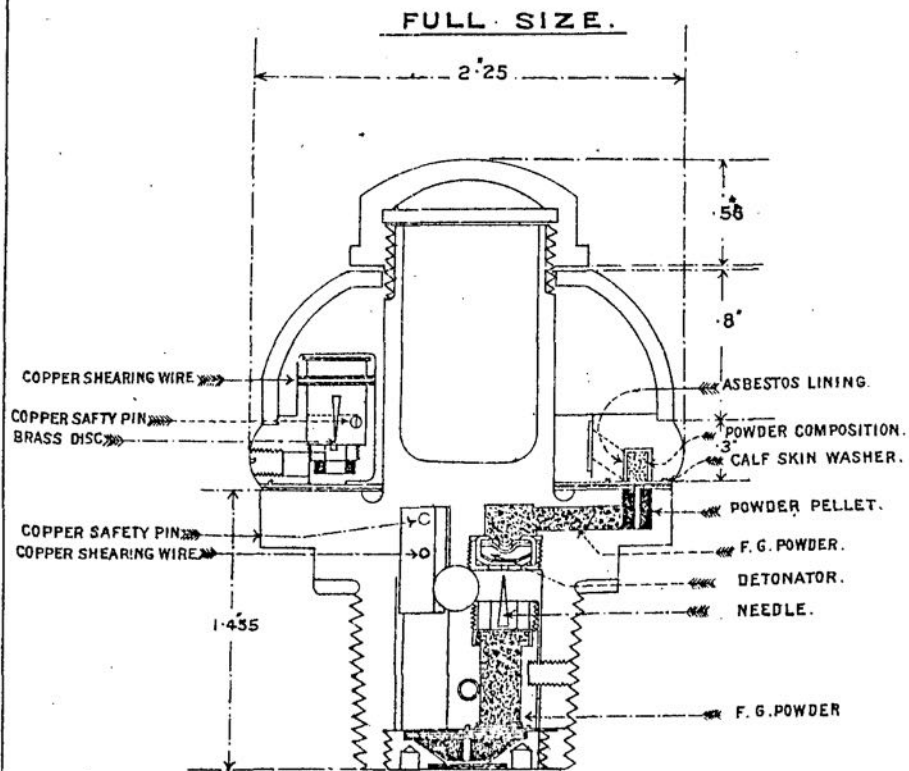
SECTION AT A. A.



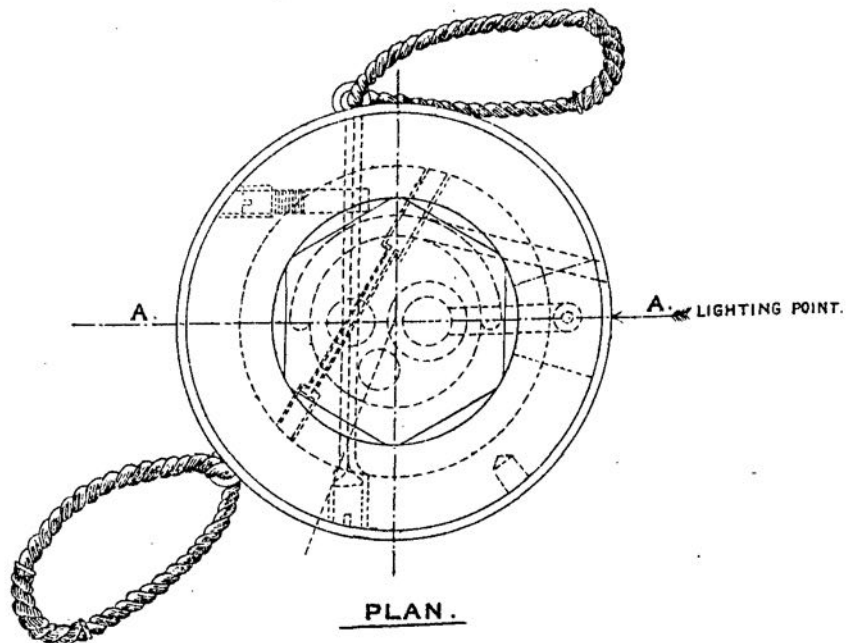
SECTION AT B. B.

Plate VII

FUZE, TIME AND PERCUSSION, MIDDLE, N^o 54, MARK III.



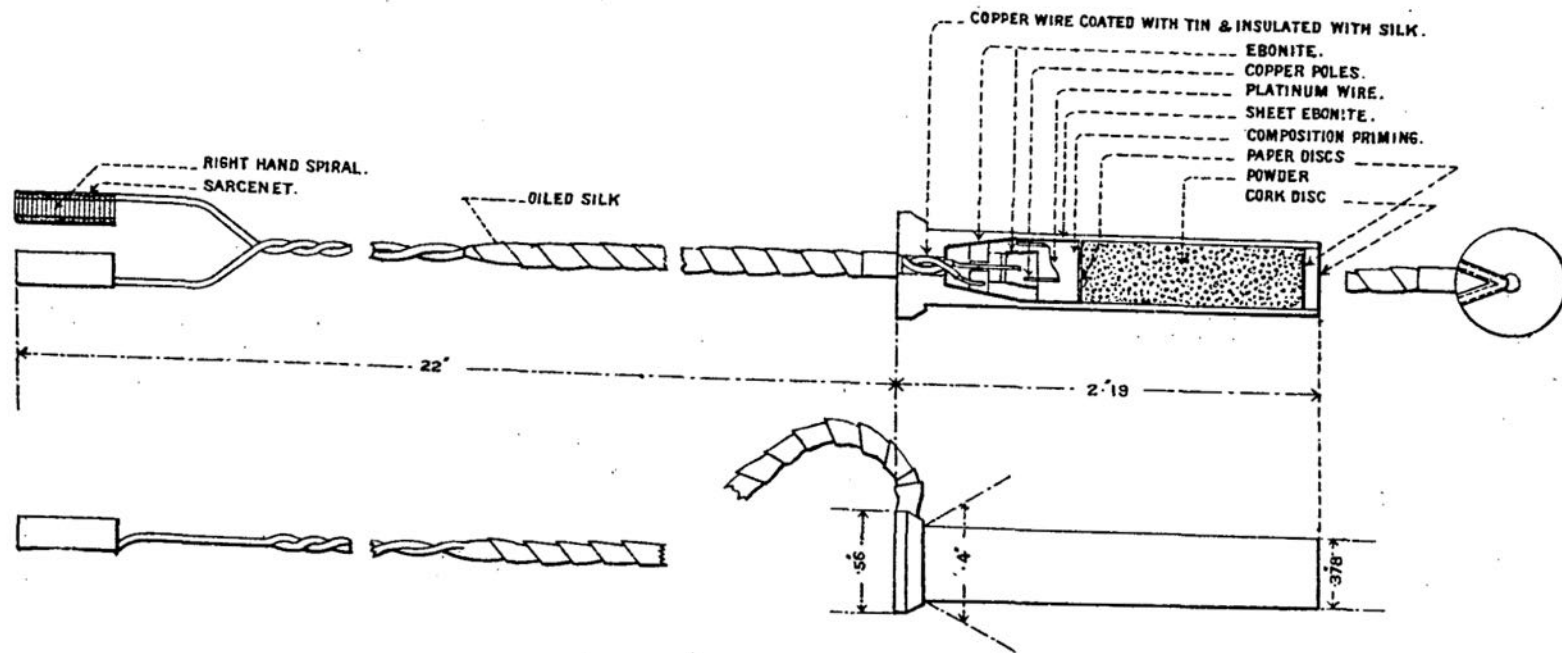
SECTION AT A. A.



TUBE, VENT-SEALING, ELECTRIC, P., MARK VII.

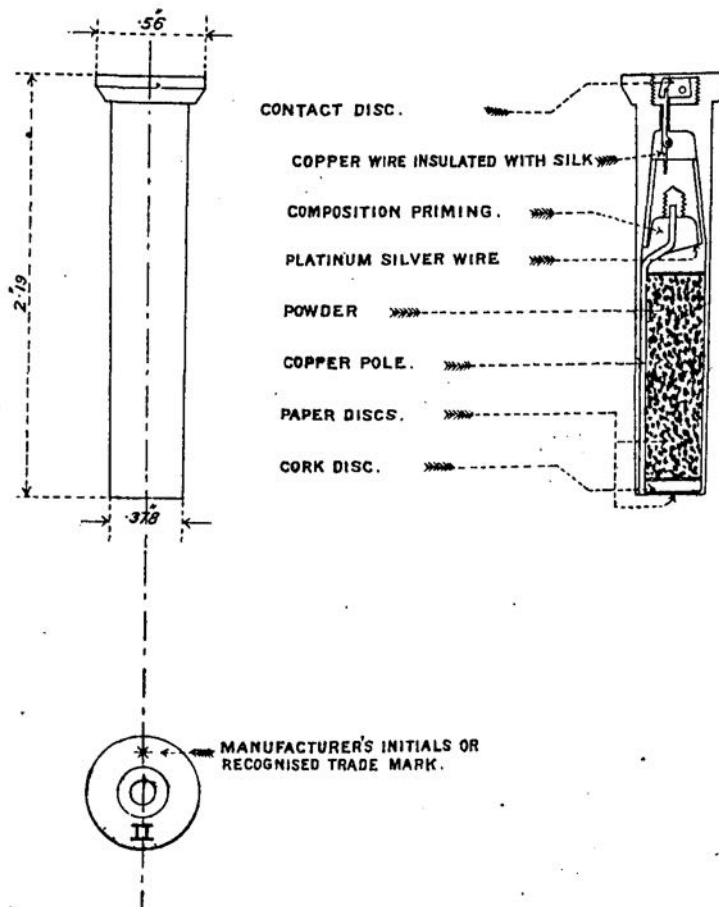
BRASS.

FULL SIZE.



TUBE, VENT-SEALING, ELECTRIC, WIRELESS, P., MARK II.

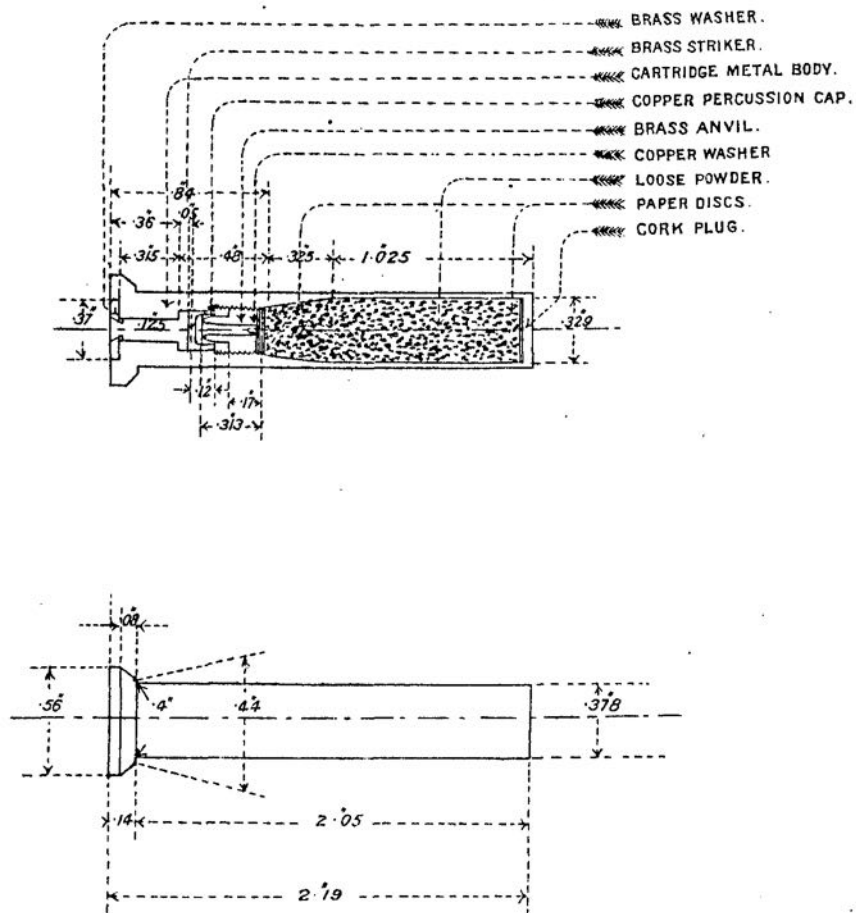
BRASS.



TUBE, VENT-SEALING, PERCUSSION, MARK II.

BRASS, FOR GUNS WITH PERCUSSION LOCKS.

FULL SIZE.



TUBE, VENT SEALING, PERCUSSION, MARK VI.

BRASS.

FULL SIZE.

